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JOINT INTEROPERABILITY TEST COMMAND
FORT HUACHUCA, ARIZONA

MILITARY STANDARD-188-212 TADIL B AND STANDARDIZATION AGREEMENT 5511, ANNEX B, LINK 11B WAVEFORM CONFORMANCE TEST PROCEDURES

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MILITARY STANDARD-188-212
TADIL B
AND
STANDARDIZATION
AGREEMENT 5511, ANNEX B,
LINK 11B WAVEFORM
CONFORMANCE TEST
PROCEDURES

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INTRODUCTION

The Tactical Digital Information Link (TADIL) B, also called Link 11B, is a secure, point-to-point data link utilizing serial transmission, frame characterization, and standard message formats at either 1200 or 2400 bits per second. Link 11B operates in the Ultra High Frequency (UHF) Frequency Modulation (FM) band with a frequency range of 225.000 megahertz (MHz) to 400.000 MHz. This tactical data link interconnects air defense and air control units.

Military Standard (MIL-STD)-188-212, Subsystem Design and Engineering Standards for Tactical Digital Information Link B and North Atlantic Treaty Organization Standardization Agreement (STANAG) 5511, annex B, establishes the minimum essential interoperability and performance requirements necessary for tactical single-channel UHF FM radio communications equipment. The MIL-STD and STANAG conformance testing will determine the level of compliance to requirements established in MIL-STD-188-212 and STANAG 5511, annex B. The requirements are listed in tables B-1 and B-2 of appendix B.

All external modems listed in test procedures will be capable of operating in the TADIL B mode. All TADIL B units under test, listed in the test procedures will operate in full duplex mode.

If test item performance does not meet a requirement, the failure and its potential operational impact will be discussed. Any required capabilities that are not implemented will also be discussed.

The Joint Interoperability Test Command will conduct standards and conformance testing at Fort Huachuca, Arizona.

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TEST PROCEDURES

SUBTEST 1. DATA SIGNALING RATES, BASIC CHARACTERISTICS, AND MODULATION

1-1 Objective. To determine the extent of compliance to the requirements of Military Standard (MIL-STD)-188-212, reference numbers 1, 2, and 3 and North Atlantic Treaty Organization Standardization Agreement (STANAG) 5511, annex B, reference number 24.

1-2 Criteria

a. Reference number 1. All Tactical Digital Information Link (TADIL) B systems shall be capable of operating at a basic data signaling rate of 1200 bits per second (bps). As a Design Objective (DO), TADIL B systems should be capable of operating at a data signaling rate of 2400 bps or at higher standard data signaling rates specified in subparagraph 5.3.5.1 of MIL-STD-188-200.

b. Reference number 2. All TADIL B modems shall comply with the applicable requirements of the current edition of MIL-STD-188-110.

c. Reference number 3. For the data signaling rate of 1200 bps, phase continuous frequency shift keying (FSK) shall be used with a center frequency of 1700 hertz (Hz), a Mark (1) frequency of 1300 Hz and a Space (0) frequency of 2100 Hz in accordance with MIL-STD-188-110.

d. Reference number 24. The modulation shall be phase continuous frequency-shift modulation used with the following characteristics:

Alternate Speed	600 Bits Per Second
Center Frequency	1500 ± 5 Hz
Space Frequency (0)	1700 ± 5 Hz
Mark Frequency (1)	1300 ± 5 Hz

1-3 Test Procedures

a. Test Equipment Required

(1) Fireberd [2 each (ea)]

(2) Unit Under Test (UUT) (2 ea)

(3) Modem (2 ea)

(4) Spectrum Analyzer

(5) Audio Breakout Box

(6) Attenuator

b. Test Configuration. Configure the equipment as shown in figures 1-1 and 1-2.

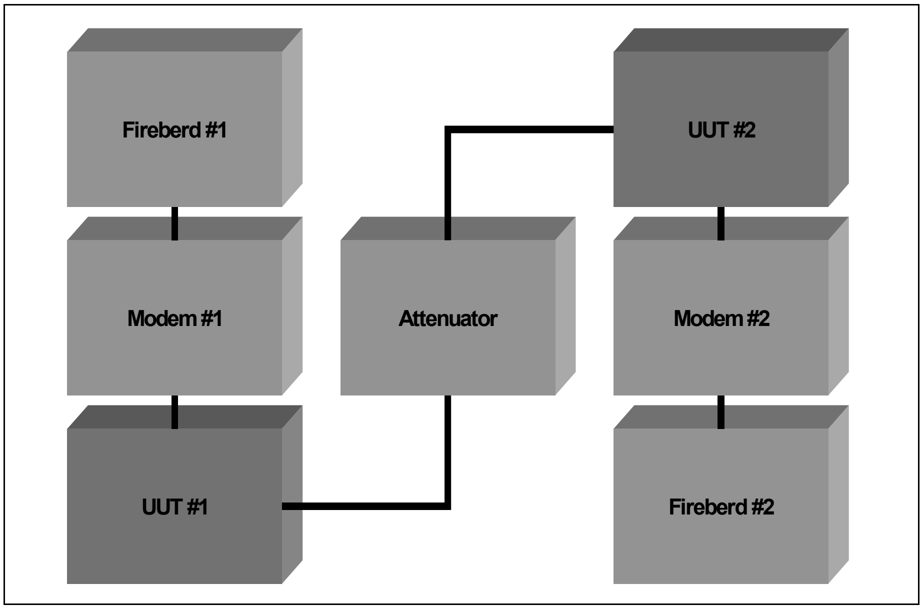

Figure 1-1. Basic Data Signaling Rates Test Equipment Configuration

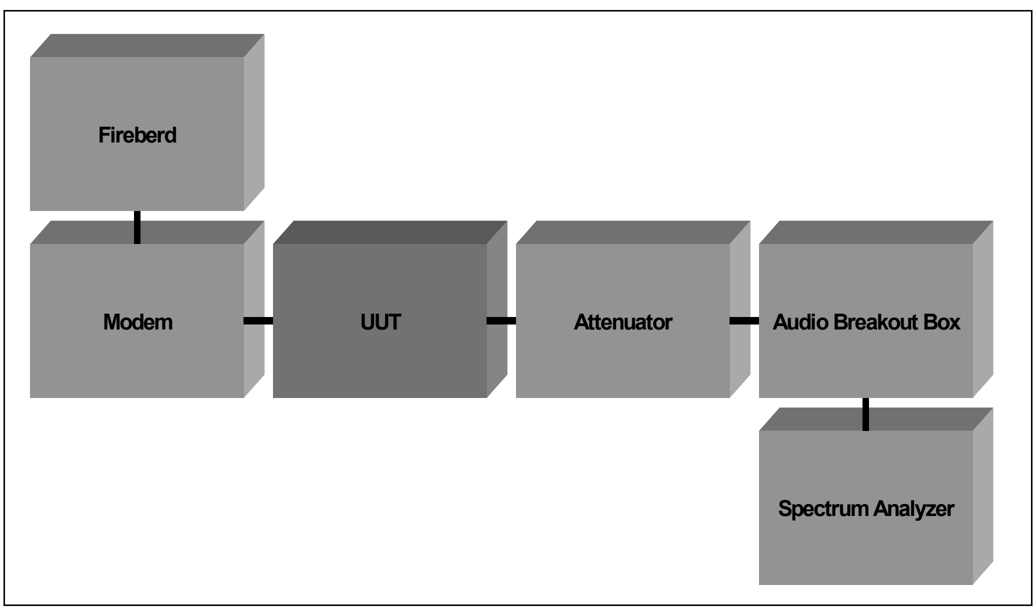

Figure 1-2. Data Signaling Rates Test Equipment Configuration

c. Test Conduct. The test procedures are listed in table 1-1.

Table 1-1. Data Signaling Rates, Basic Characteristics, and Modulation Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 1.			
1	Configure equipment.	As shown in figure 1-1.	
2	Configure Fireberd 1 and 2.	Data rate: 63 Synchronous Sync frequency: 1.2 kHz Duration: 30 minutes	
3	Configure modem 1 and 2.	Full duplex Carrier frequency: 1700 Hz 1200 bps	
4	Configure UUT 1 and 2.	Frequency: 225.000 MHz Plain text, Single channel	
5	Start Fireberd 1.	Does Fireberd 2 receive data for 30 minutes?	Record results on data collection form and test results matrix.
6	Stop and reset Fireberd 1 and 2.		
7	Change frequency on UUT to 295.000 MHz. Start Fireberd 1.	Does Firebird 2 receive data for 30 minutes?	Record results on data collection form and test results matrix.
8	Stop and reset Fireberd 1 and 2.		
9	Change frequency on UUT to 400.000 MHz. Start Fireberd 1.	Does Firebird 2 receive data for 30 minutes?	Record results on data collection form and test results matrix.
10	Stop Fireberd 1. Reset Fireberd 1 and 2.	Change bps on modem to 2400 bps.	
11	Change frequency on UUT to 295.000 MHz. Start Fireberd 1.	Does Firebird 2 receive data for 30 minutes?	Record results on data collection form and test results matrix.
12	Stop and reset Fireberd 1 and 2.		
13	Change frequency on UUT to 295.000 MHz. Start Fireberd 1.	Does Firebird 2 receive data for 30 minutes?	Record results on data collection form and test results matrix.
14	Stop and reset Fireberd 1 and 2.		
15	Change frequency on UUT to 400.000 MHz. Start Fireberd 1.	Does Firebird 2 receive data for 30 minutes?	Record results on data collection form and test results matrix.
16	Repeat steps 2 through 6 for data rates higher than 2400 bps.		
The following procedures refer to reference number 2.			
17	Refer to Joint Interoperability Test Command's MIL-STD-188-110B Conformance Test Procedures for compliance for all TADIL B modem requirements listed in the table of contents.	Test procedures are located at http://jitc.fhu.disa.mil/jtrs/	Record results on data collection form and test results matrix.

Table 1-1. Data Signaling Rates, Basic Characteristics, and Modulation Test Procedures (continued)

Step	Action	Settings/Action	Result
The following procedures refer to reference numbers 3 and 24.			
18	Configure equipment.	As shown in figure 1-2.	
19	Configure Fireberd.	Data rate: 63 Synchronous Sync Frequency: 1.2 kHz Duration: Continuous	
20	Configure modem.	Full Duplex Carrier Frequency: 1700 Hz 1200 bps Mode: FSK	
21	Configure UUT.	Frequency: 312.000 MHz Plain text, Single channel	
22	Configure spectrum analyzer.	Center Frequency: 1700 Hz Span: 3.4 kHz Bandwidth average: On 100.	
23	Start Fireberd. Observe spectrum analyzer display.	Does the spectrum analyzer display a mark frequency of 1300 Hz?	Record results on data collection form and test results matrix.
24		Does the spectrum analyzer display a space frequency of 2100 Hz?	Record results on data collection form and test results matrix.
25	Stop Fireberd.		
26	Reconfigure modem.	Full Duplex Carrier Frequency: 1500 Hz 600 bps Mode: FSK	
27	Start Fireberd. Observe spectrum analyzer display.	Does the spectrum analyzer display a mark frequency of 1300 Hz ± 5 Hz?	Record results on data collection form and test results matrix.
28		Does the spectrum analyzer display a space frequency of 1700 Hz ± 5 Hz?	Record results on data collection form and test results matrix.

Legend:

± - plus or minus	Hz - hertz	TADIL - Tactical Digital Information Link
# - number	MHz - megahertz	UUT - Unit Under Test
bps - bits per second	MIL-STD - Military Standard	
FSK - Frequency Shift Keying	sync - synchronous	

1-4 Presentation of Results. The results will be shown in table 1-2 indicating the requirement and measured value or indications of capability.

Table 1-2. Data Signaling Rates, Basic Characteristics, and Modulation Test Results

Reference Number	MIL-STD/ STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
1	MIL-STD 188-212 5.2.3	All TADIL B systems shall be capable of operating at a basic data signaling rate of 1200 bits per second (bps). As a DO, TADIL B systems should be capable of operating at a data signaling rate of 2400 bps or at higher standard data signaling rates specified in subparagraph 5.3.5.1 of MIL-STD-188-200.	Be capable of operating at a basic data signaling rate of 1200 bits per second (bps).			
2	MIL-STD 188-212 5.2.5	All TADIL B modems shall comply with the applicable requirements of the current edition of MIL-STD-188-110.	All TADIL B modems shall comply with MIL-STD-188-110.			
3	MIL-STD 188-212 5.2.5.1	For the data signaling rate of 1200 bps, phase continuous frequency shift keying (FSK) shall be used with a center frequency of 1700 hertz (Hz), a mark (1) frequency of 1300 Hz and a space (0) frequency of 2100 Hz in accordance with MIL-STD-188-110.	Center frequency of 1700 hertz, mark (1) frequency of 1300 Hz and a space (0) frequency of 2100 Hz.			
24	STANAG 5511 annex B 2.2.1.a	Basic speed 600 bps Mark frequency (1) 1300 ± 5 Hz.	1300 ± 5 Hz			
		Alternate speed 600 bps Center frequency 1500 ± 5 Hz.	1500 ± 5 Hz			
		Alternate speed 600 bps Space frequency (0) 1700 ± 5 Hz.	1700 ± 5 Hz			

Legend:
± - plus or minus
bps - bits per second
DO - design objective
FSK - Frequency Shift Keying
Hz - hertz
MIL-STD - Military Standard
STANAG - Standardization Agreement
TADIL - Tactical Digital Information Link

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SUBTEST 2. TERMINAL AND TRANSMISSION SUBSYSTEM BIT ERROR RATE (BER), ANALOG/DIGITAL SIGNAL CONNECTION

2-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference number 4.

2-2 Criteria. Reference number 4. The BER attributable directly to the terminal subsystem shall not exceed 1 erroneous bit in 10,000,000 bits transmitted at the applicable modulation rate or data signaling rate, when the output of the transmitting terminal subsystem is connected directly to the input of the receiving terminal subsystem. This requirement shall be achieved while employing a test pattern over any continuous 5-hour period. The test pattern for measuring the BER shall be inserted at that point in the transmitting terminal subsystem that superimposes the TADIL B message onto the TADIL B transmission frame format (paragraph 5.2.1). The test pattern shall be measured at that point in the receiving terminal subsystem that samples the TADIL B transmission frame format.

2-3 Test Procedures

a. Test Equipment Required

(1) Fireberd (2 ea)

(2) Modem (2 ea)

(3) UUT (2 ea)

b. Test Configuration. Configure the equipment as shown in figure 2-1.

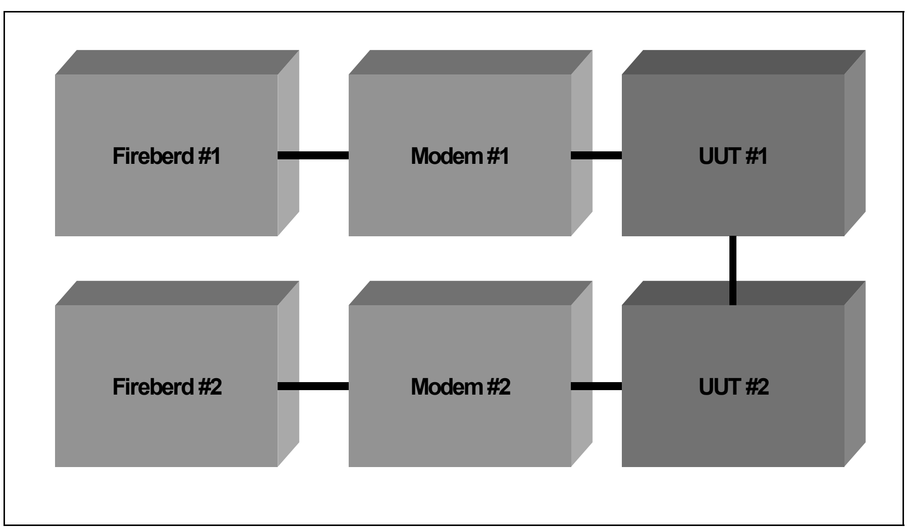

Figure 2-1. Terminal and Transmission Subsystem BER Test Equipment Configuration

c. Test Conduct. The test procedures are listed in table 2-1.

Table 2-1. Terminal and Transmission Subsystem BER Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 4.			
1	Configure equipment.	As shown in figure 2-1.	
2	Configure Fireberd 1 and 2.	Data Pattern: 1:1 Synchronous Sync Frequency: 1.2 kHz Duration: 5 hours Test interval: 10,000,000 bits Analysis: BER	
3	Configure modem 1 and 2.	FSK Full Duplex Carrier Frequency: 1700 Hz 1200 bps	
4	Configure UUT.	Frequency: 312.000 MHz Plain text, Single channel	
5	Start Fireberd 1.	Test will run for a 5-hour period.	
6	View test results on Fireberd 2.	Record erroneous rate at 1200 bps.	Record measurements on data collection form and test results matrix.
7	Change settings on the modem.	2400 bps	
9	Press restart on the Fireberd 1 to start test.	Test will run for a 5-hour period.	
10	View test results on Fireberd 2.	Record erroneous rate at 2400 bps.	Record measurements on data collection form and test results matrix.
11	Repeat steps 2 through 6 for data rates higher than 2400 bps.		
Legend: BER - Bit Error Rate bps - bits per second	FSK - Frequency Shift Keying Hz - hertz	kHz - kilohertz sync - Synchronous	

2-4 Presentation of Results. The results will be shown in table 2-1 indicating the requirement and measured value or indications of capability.

Table 2-2. Terminal and Transmission Subsystem BER Test Results

Reference Number	MIL-STD Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
4	MIL-STD 188-212 5.2.7	The BER attributable directly to the terminal subsystem shall not exceed 1 erroneous bit in 10,000,000 bits transmitted at the applicable modulation rate or data signaling rate, when the output of the transmitting terminal subsystem is connected directly to the input of the receiving terminal subsystem. This requirement shall be achieved while employing a test pattern over any continuous 5-hour period. The test pattern for measuring the BER shall be inserted at that point in the transmitting terminal subsystem which superimposes the TADIL B massage onto the TADIL B transmission frame format. (See 5.2.1 note 2).	The BER attributable directly to the terminal subsystem shall not exceed 1 erroneous bit in 10,000,000 bits transmitted over any continuous 5-hour period.			

Note 1: The test pattern for measuring the BER is not standardized and will be defined in applicable equipment or subsystem specifications.
Note 2: 5.2.1: The test pattern shall be measured at that point in the receiving terminal subsystem which samples the TADIL B transmission frame format.
Legend:
BER - Bit Error Rate MIL-STD - Military Standard TADIL - Tactical Digital Information Link

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SUBTEST 3. ELECTRICAL CHARACTERISTICS OF DIGITAL INTERFACES

3-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference numbers 5 and 8.

3-2 Criteria

a. Reference number 5. The electrical characteristics of the digital channel interface between the terminal subsystem and the transmission subsystem shall comply with the applicable requirements of the current edition of MIL-STD-I88-114.

b. Reference number 8. The electrical characteristics of the interfaces between the equipment of the terminal subsystem shown in figure 3-1 shall comply with the applicable requirements of the current edition of MIL-STD-188-114.

Note: MIL-STD-188-114, Electrical Characteristics of Digital Interface Circuits, paragraphs 5.1 through 5.3, specifies the electrical characteristics of digital interface circuits in terms of direct electrical measurements of the interface circuits' unbalanced or balanced generator component. Therefore, the following criteria have been developed in terms of an unbalanced or balanced generator.

c. Unbalanced Generator Criteria for an Unbalanced Voltage Digital Interface Circuit:

(1) Open Circuit Measurement. The magnitude of the voltage (V_o) measured between the output terminal and ground shall not be less than 4 volts (V) nor more than 6 V for any interface circuit in either binary state ($4 \text{ V} \leq |V_o| \leq 6 \text{ V}$). See figure 3-1.

(2) Test Termination Measurement. The magnitude of the voltage (V_t), measured between the output terminal and ground, shall not be less than 90 percent of the magnitude of V_o with a test load (R_t) of 450 ohm $\pm$1 percent connected between the generator output terminal and generator circuit ground, or ($|V_t| \geq 0.9|V_o|$, when $R_t = 450$ ohm, $\pm$1 percent). See figure 3-1.

(3) Short Circuit Measurement. The magnitude of the current (I_s) flowing through the generator output terminal shall not exceed 150 milliamperes (mA) when the generator output terminal is short circuited to generator circuit ground, ($|I_s| \leq 150$ mA). See figure 3-1.

(4) Power-Off Measurement. The magnitude of the generator output leakage current (I_x) shall not exceed 100 microamperes (μA) under power-off conditions, with a voltage V_x ranging between +6 V and -6 V applied between the generator output terminal and generator circuit ground, or ($|I_x| \leq 100\ \mu$A, when $-6 \text{ V} \leq V_x \leq +6 \text{ V}$). See figure 3-1.

d. Balanced Generator Criteria for a Balanced Voltage Digital Interface Circuit:

Note: MIL-STD-188-114, Electrical Characteristics of Digital Interface Circuits, paragraph 4.4.1, describes the three types of balanced generators. The type I balanced generator is best suited to meet the requirements of the data modem. The following criteria have been developed in terms of a balanced generator.

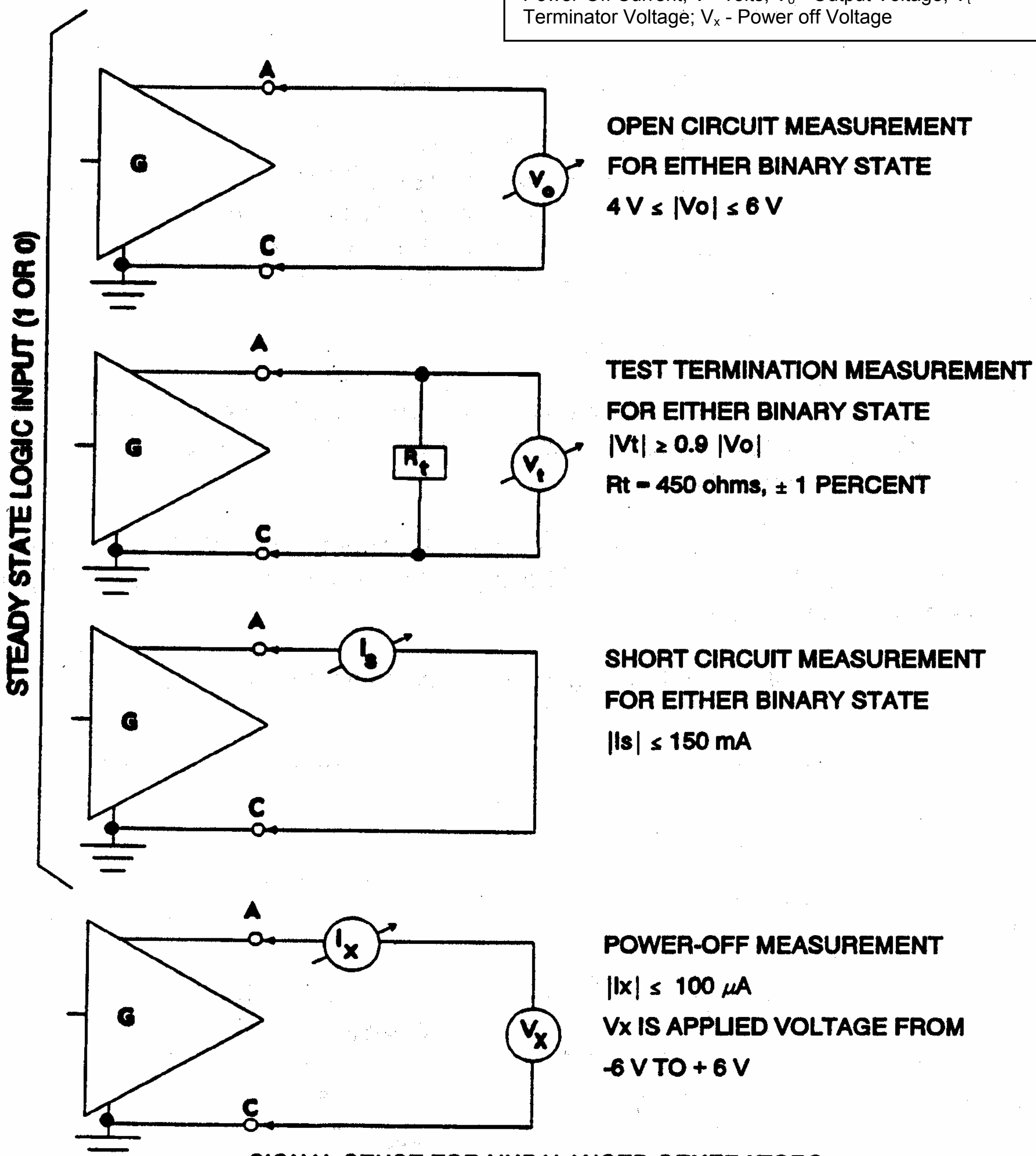
(1) Open Circuit Measurement. The magnitude of the differential voltage (V_o) between two generator output terminals shall not be less than 4 V nor more than 6 V ($4\ V \leq | V_o | \leq 6\ V$). The magnitude of the open circuit voltage Voa and Vob between the generator output terminals and the generator circuit ground shall not be less than 2 V nor more than 3 V, or ($2\ V \leq |V_{oa}| \leq 3\ V$ and $2\ V \leq |V_{ob}| \leq 3\ V$). See figure 3-2.

(2) Test Termination Measurement. With a test load (R_t) of two resistors, 50 ohms (Ω) $\pm$1 percent each, connected in series between the generator output terminals, the magnitude of the differential voltage V_t, between the generator output terminals, shall not be less than one-half of the absolute value of V_o, or ($|V_t| \geq 0.5 | V_o |$). For the opposite binary state, the polarity of V_t shall be reversed (t). The magnitude of the difference of the absolute values of V_t and V_t shall not be more than 0.4 V, or $|V_t| - |V_t| \leq 0.4\ V$. The magnitude of the difference of V_{os} and V_{os} for the opposite binary state shall not be more than 0.4 V, or $|V_{os} - V_{os}| \leq 0.4\ V$. The magnitude of the generator offset voltage Vos between the center point of the test load and generator circuit ground shall not be more than 0.4 V for either binary state, or $|V_{os}| \leq 0.4\ V$. See figure 3-2.

(3) Short Circuit Measurement. With the generator output terminals short-circuited to generator circuit ground, the magnitudes of the currents (I_{sa} and I_{sb}) flowing through each generator output terminal shall not exceed 150 mA for either binary state, ($|I_{sa}| \leq 150$ mA and $|I_{sb}| \leq 150$ mA). See figure 3-2.

(4) Power-Off Measurement. Under power-off conditions, the magnitude of the generator output leakage current I_{xa} and I_{xb} shall not exceed 100 μA with voltage V_x ranging between +6 V and -6 V applied between each generator output terminal and generator circuit ground, or ($|I_{xa}| \leq 100\ \mu A$ and $|I_{xb}| \leq 100\ \mu A$, when $-6\ V \leq V_x \leq +6\ V$). See figure 3-2.

Legend: µA – microamps; G - Generator; I - Current; I_x – Power-Off Current; V - volts; V_o - Output Voltage; V_t = Terminator Voltage; V_x - Power off Voltage

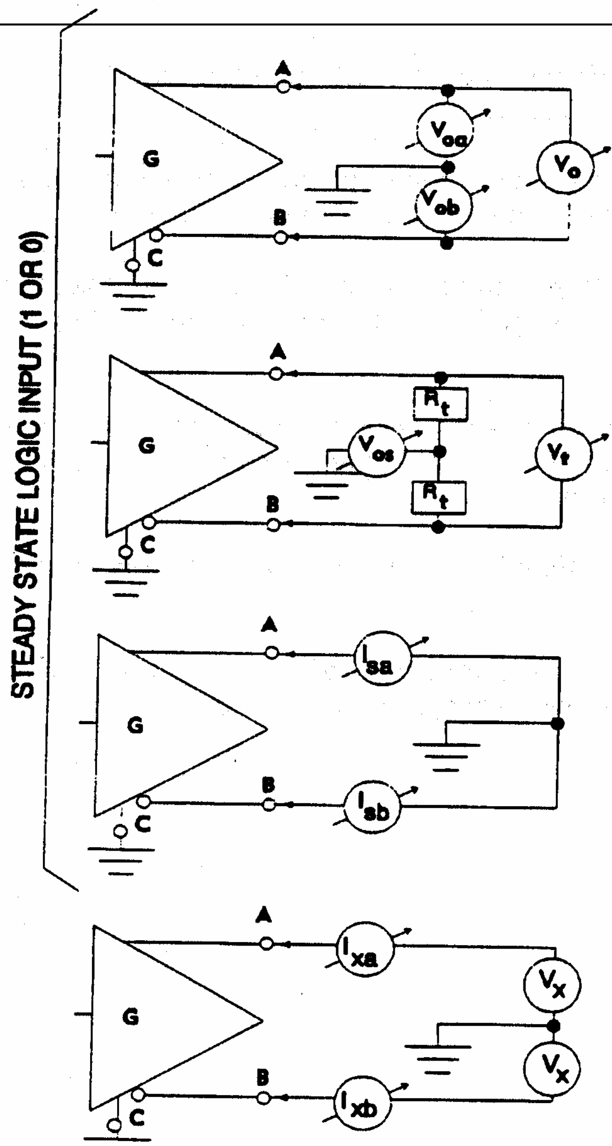


SIGNAL SENSE FOR UNBALANCED GENERATORS

VOLTAGE POLARITY	DATA	TIMING	CONTROL and ALARM
Point A negative with respect to Point C	1 or MARK	OFF (QUIESCENT)	OFF
Point A negative with respect to Point C	0 or SPACE	ON (ACTIVE)	ON

Figure 3-1. Measurement Diagram for Unbalanced Circuit

Legend: G - Generator; I_{sa} - Current through node A; I_{sb} - Current through node B; I_{xa} - Current through node B; mA - milliampere; V_{do} - Voltage between the output and point B; V_o - Output Voltage; V_{oa} - Voltage point A and the output; V_{os} - Voltage between O and S; V_x - applied Voltage; V_t - Differential Voltage; µA - microamperes



OPEN CIRCUIT MEASUREMENT FOR EITHER BINARY STATE

$4\ V \leq |Vo| \leq 6\ V$

$2\ V \leq |Voa| \leq 3$

$2\ V \leq |Vob| \leq 3$

TEST TERMINATION MEASUREMENT FOR EITHER BINARY STATE

$|Vt| \geq 0.5\ |Vo|$

$||Vt| - |\bar{Vt}|| \leq 0.4\ V$

$|Vos - \bar{Vos}| \leq 0.4\ V$

$|Vos| \leq 0.4\ V$

SHORT CIRCUIT MEASUREMENT FOR EITHER BINARY STATE

$|Isa| \leq 150$ mA

$|Isb| \leq 150$ mA

POWER-OFF MEASUREMENT

$|Ixa| \leq 100\ \mu A$

$|Ixb| \leq 100\ \mu A$

Vx IS APPLIED VOLTAGE

Vx FROM -6 V TO +6 V

SIGNAL SENSE FOR BALANCED GENERATORS

VOLTAGE POLARITY	DATA	TIMING	CONTROL and ALARM
Point A negative with respect to Point B	1 or MARK	OFF (QUIESCENT)	OFF
Point A negative with respect to Point B	0 or SPACE	ON (ACTIVE)	ON

Figure 3-2. Measurement Diagram for Balanced Circuit

3-3 Test Procedures

a. Test Equipment Required

(1) Digital Volt Meter

(2) Oscilloscope

(3) Power Supply

(4) UUT

b. Test Configuration. Configure the equipment as shown in figure 3-3.

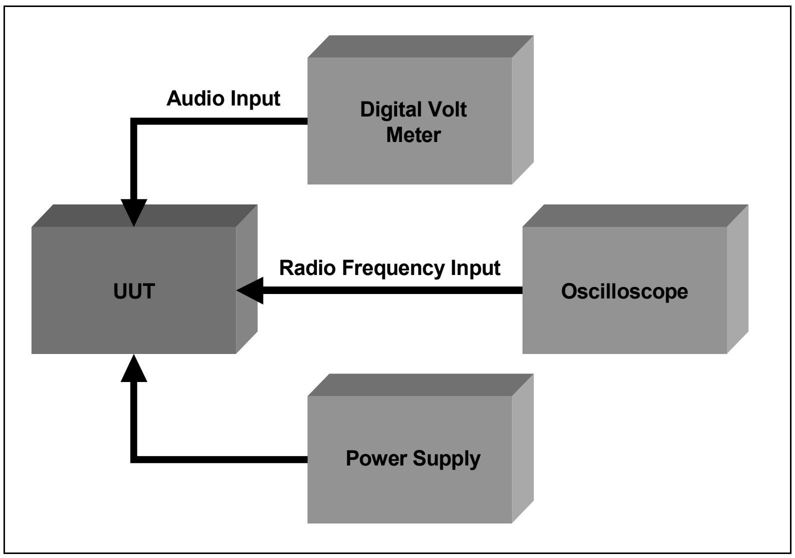


Figure 3-3. Electrical Characteristics of Digital Interfaces Test Equipment Configuration

c. Test Conduct. The procedures for this subtest are listed in table 3-1.

Table 3-1. Electrical Characteristics of Digital Interfaces Test Procedures

Step	Action	Settings/Action	Result
The following procedure is for reference numbers 5 and 8.			
1	Configure equipment.	As shown in figure 3-3.	
2	Determine the type of interface that has been implemented (balanced or unbalanced).		
3	Conduct open circuit, test termination, and short circuit measurements for both binary states.	See figures 3-1 and 3-2.	

Table 3-1. Electrical Characteristics of Digital Interfaces Test Procedures (continued)

Step	Action	Settings/Action	Result
4	Power down system, apply external voltage from power supply to appropriate test points, and measure leakage current.		
5	Voltage and current readings will be taken from the respective measuring points as shown in figure 3-1 or 3-2, depending on which interface is implemented.		Record measurement on data collection form and requirement matrix.

3-4 Presentation of Results. The results will be shown in table 3-2 indicating the requirement and measured value or indications of capability.

Table 3-2. Electrical Characteristics of Digital Interfaces Test Results

Reference Number	MIL-STD Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
5	MIL-STD 188-212 5.2.8.1.1	The electrical characteristics of the interfaces between the equipment of the terminal subsystem shown in figure 1 shall comply with the applicable requirements of the current edition of MIL-STD-188-114.	For unbalanced generator and balanced generator required values, refer to pages C-11 and 12 of data collection forms.			
8	MIL-STD 188-212 5.2.8.3.1	The electrical characteristics of the digital channel interface between the terminal subsystem and the transmission subsystem shall comply with the applicable requirements of the current edition of MIL-STD-I88-114.	For unbalanced generator and balanced generator required values, refer to pages C-11 and 12 of data collection forms.			

Note: Any or all of the equipment of the terminal subsystem may be integrated and combined into a single piece of equipment. when combined into a single piece of equipment, MIL-STD-188-114 does not apply to internal equipment connections.
Legend:
MIL-STD - Military Standard

SUBTEST 4. IMPEDANCE AND ELECTRICAL SYMMETRY

4-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference numbers 6 and 9.

4-2 Criteria

a. Reference number 6. The impedance at the modulator output and the demodulator input shall each be 600 ohms, balanced to ground, with a minimum return loss of 26 decibels (dB) against a 600-ohm resistance over the frequency band from 300 Hz to 3400 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level [-40 dB referred to one milliwatt (dBm) referred to Zero Transmission Level (dBm0)]. The audio input shall be balanced and ungrounded with 600-ohm terminations.

b. Reference number 9. The impedance of the transmitting and receiving terminals of a nominal 4 kilohertz (kHz) Voice Frequency (VF) channel interface for quasi-analog signals shall each be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3400 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).

4-3 Test Procedures

a. Test Equipment Required

(1) UUT

(2) Multimeter

(3) Impedance/Phase-Gain Analyzer

(4) Transmission Impairment Measurement Set (TIMS)

(5) Audio Analyzer (2 ea)

(6) 500-Ohm Resistor

(7) 600-Ohm Balanced Transformer

b. Test Configuration. Configure the equipment as shown in figures 4-1 and 4-2.

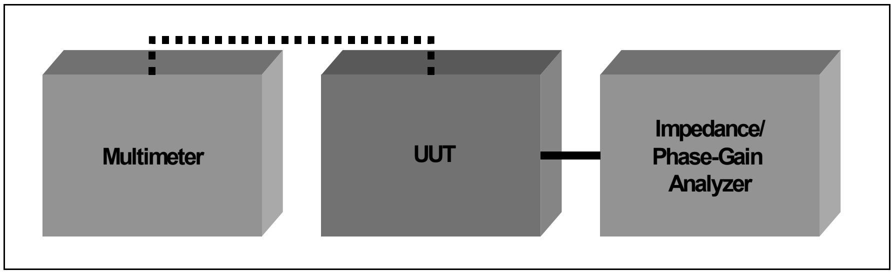


Figure 4-1. Impedance Test Equipment Configuration

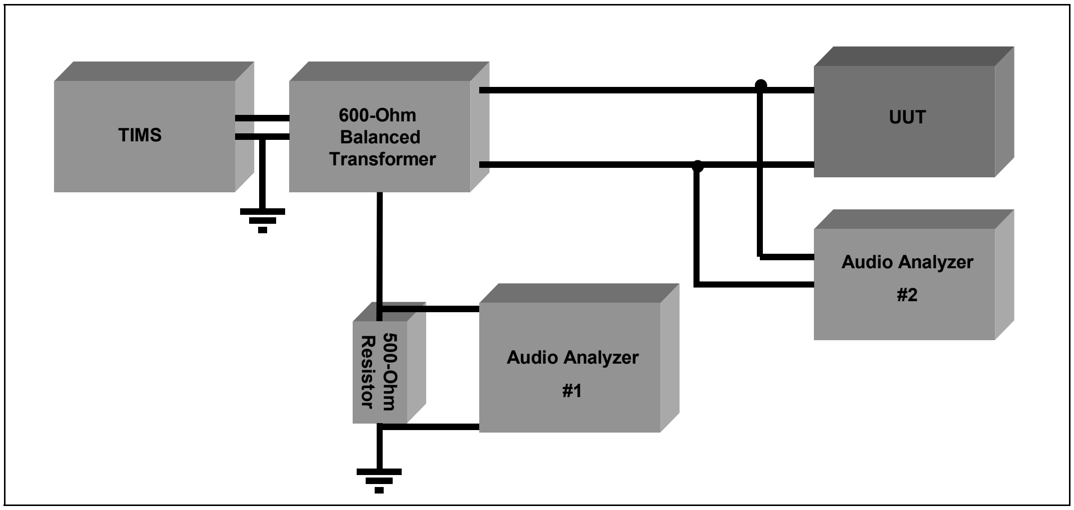


Figure 4-2. Electrical Symmetry Test Equipment Configuration

c. Test Conduct. The test procedures are listed in table 4-1.

Table 4-1. Impedance Input Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference numbers 6 and 9.			
1	Configure equipment.	As shown in figure 4-1.	
2	Check with manufacturer's specifications on the correct balanced and grounded pins for testing the modulator output and the demodulator input of the UUT.	Using the multimeter, is the audio input balanced and ungrounded with 600-ohms terminations? Record results.	Record results on data collection form and test results matrix.
3	Use the Impedance/Gain-Phase Analyzer to measure the balanced terminal impedance at the data input connector across the data input frequency range.	Check manufacturer's specifications regarding the correct data input frequency range.	Record results on data collection form and test results matrix.
Legend: UUT - Unit Under Test			

4-2. Electrical Symmetry Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference numbers 6 and 9.			
1	Configure equipment.	As shown in figure 4-2.	
2	Configure UUT.	Frequency: 225.000 MHz Plain text, Single channel	
3	Configure TIMS.	Transmit 0 dBm 300 Hz tone 600 Ohm Transmit/Receive	
4	Configure audio analyzer 1 and 2.	Measurement: SINAD Low pass filter: 30 kHz	
5	Turn receiver off. Disconnect power source.		
6	Adjust the TIMS to a +10-dBm signal at 300 Hz.	The difference, in dB, between the voltage readings observed on audio analyzer 1 and the reading on audio analyzer 2 are taken as the longitudinal balance indication.	Record measurements on data collection form and test results matrix.
7	Adjust audio tone 400 Hz to 3000 Hz in 100-Hz steps recording results for each 100-Hz step.	The difference, in dB, between the voltage readings observed on audio analyzer 1 and the reading on audio analyzer 2 are taken as the longitudinal balance indication.	Record measurements on data collection form and test results matrix.
8	Change frequency on UUT to 242.500 MHz. Repeat steps 3 through 7 recording each 100-Hz step.	The difference, in dB, between the voltage readings observed on audio analyzer 1 and the reading on audio analyzer 2 are taken as the longitudinal balance indication.	Record measurements on data collection form and test results matrix.
9	Change frequency on UUT to 260.000 MHz. Repeat steps 3 through 7 recording each 100-Hz step.	The difference, in dB, between the voltage readings observed on audio analyzer 1 and the reading on audio analyzer 2 are taken as the longitudinal balance indication.	Record measurements on data collection form and test results matrix.
10	Change frequency on UUT to 277.500 MHz. Repeat steps 3 through 7 recording each 100-Hz step.	The difference, in dB, between the voltage readings observed on audio analyzer 1 and the reading on audio analyzer 2 are taken as the longitudinal balance indication.	Record measurements on data collection form and test results matrix.
11	Change frequency on UUT to 295.000 MHz. Repeat steps 3 through 7 recording each 100-Hz step.	The difference, in dB, between the voltage readings observed on audio analyzer 1 and the reading on audio analyzer 2 are taken as the longitudinal balance indication.	Record measurements on data collection form and test results matrix.
12	Change frequency on UUT to 330.000 MHz. Repeat steps 3 through 7 recording each 100-Hz step.	The difference, in dB, between the voltage readings observed on audio analyzer 1 and the reading on audio analyzer 2 are taken as the longitudinal balance indication.	Record measurements on data collection form and test results matrix.

Table 4-2. Electrical Symmetry Test Procedures (continued)

Step	Action	Settings/Action	Result
13	Change frequency on UUT to 365.000 MHz. Repeat steps 3 through 7 recording each 100 Hz step.	The difference, in dB, between the voltage readings observed on audio analyzer 1 and the reading on audio analyzer 2 are taken as the longitudinal balance indication.	Record measurements on data collection form and test results matrix.
14	Change frequency on UUT to 400.000 MHz. Repeat steps 3 through 7 recording each 100 Hz step.	The difference, in dB, between the voltage readings observed on audio analyzer 1 and the reading on audio analyzer 2 are taken as the longitudinal balance indication.	Record measurements on data collection form and test results matrix.
Legend: dB - decibels dBm - dB referred to one milliwatt Hz - hertz kHz - kilohertz	MHz - megahertz SINAD - Signal-Plus-Noise-Plus-Distortion to Noise-Plus-Distortion Ratio TIMS - Transmission Impairment Measurement Set UUT - Unit Under Test		

4-4 Presentation of Results. The results will be shown in table 4-3 indicating the requirement and measured value or indications of capability.

Table 4-3. Impedance Input and Electrical Symmetry Test Results

Reference Number	MIL-STD Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
6	MIL-STD 188-212 5.2.8.2.1	The impedance at the modulator output and the demodulator input shall each be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3400 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).	Be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3400 Hz.			
			40 dB below reference level.			

Table 4-3. Impedance Input and Electrical Symmetry Test Results (continued)

Reference Number	MIL-STD Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
9	MIL-STD 188-212 5.3.2.1.4	The impedance at the modulator output and the demodulator input shall each be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3400 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).	Be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3400 Hz.			

Legend:
dB - decibels
dBm - dB referred to one milliwatt
dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point
Hz - hertz
MIL-STD - Military Standard

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SUBTEST 5. QUASI-ANALOG SIGNAL LEVELS AND INSERTION LOSS

5-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference numbers 7, 10, 16, and 18.

5-2 Criteria

a. Reference number 7. The transmitted quasi-analog signal level at the modulator output shall be adjusted such that the signal level stated in paragraph 5.3.2.1.5 is obtained at the input of the Voice Frequency (VF) channel of the transmission subsystem.

b. Reference number 10. For the tactical subsystems type I and type III (See table III), the quasi-analog signal level shall be -13 dBm0 at the input terminals, and shall be -13 dBm0, ± 0.5 dB, at the output terminals of the Frequency Division Multiplex (FDM) equipment of the transmission subsystem. For the tactical subsystem type II, the quasi-analog signal level shall be -6 dBm0 (i.e., -10 dBm at a -4 Transmission Level Point (TLP) at the input terminals and shall be -6 dBm0, ±0.5 dB, at the output terminals of the Time Division Multiplex/Pulse Code Modulation (TDM/PCM) equipment of the transmission subsystem. The interconnection between VF channels of the tactical subsystems type I or type III and VF channels of the tactical subsystem type II shall be in accordance with 5.3.2.5.

c. Reference number 16. The insertion loss of a VF channel shall be 0 dB, ±0.5 dB, measured at 1000 Hz, ±25 Hz.

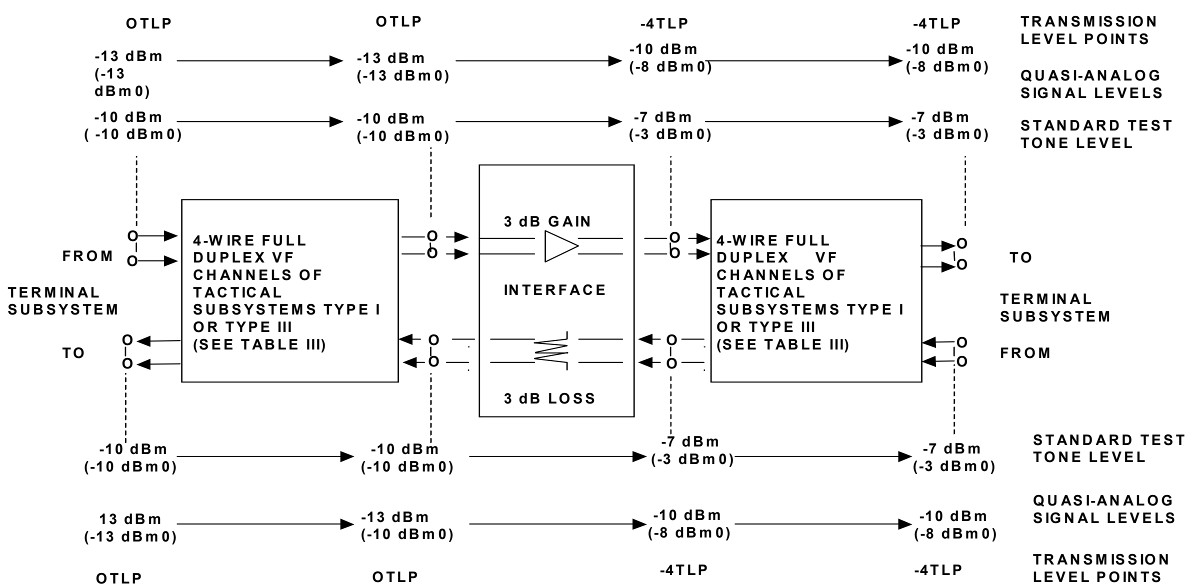
d. Reference number 18. For data transmission with modulation rates of 1200 baud (Bd) or less over VF channels, the insertion loss versus frequency characteristic, referenced to 1000 Hz, shall not exceed the values given in table 5-1 over the frequency bands stated. Loss is indicated by a (+) and gain by a (-) sign (figure 5-2).

Note: The parameter values listed in table 5-1 are identical to the values for the D2 circuit parameters which are part of the Defense Communications System (DCS) technical schedule published in Defense Information System Agency Circular 300-175-9 [formally know as Defense Communications Agency Circular (DCAC) 300-175-9]. The DCS technical schedule is based on corresponding parameter values used by commercial carriers. The parameter values of the DCS technical schedule are considered to be the best information available to specify VF-channel characteristics necessary for acceptable data transmission. However, experience has shown that VF channels may provide acceptable data service when the measured parameters are close to, but not exactly within the limits of, the values listed in tables 5-1 and 5-2. Therefore, the parameter values listed in these tables should not be used exclusively to determine the need for regenerating data signals and conditioning data channels.

Table 5-1. Switched Multichannel Communications Subsystems

MIL-STD-188-200 Terms	Probable Max Distance	Multiplexer Equipment	TLP	Quasi-Analog Signal Level (See Note 1)	Standard Test Tone Level (See Note 1)	MIL-STD-188-200 Terms
Tactical Subsystem Type I	300 km	FDM	0TLP	-13 dBm0	-10 dBm0	Tactical Highly Maneuverable System
Tactical Subsystem Type II	300 km	TDM/PCM	-4 TLP	-6 dBm0	-3 dBm0	
		FDM (See Note 2)	-4 TLP	-6 dBm0	-3 dBm0	
Tactical Subsystem Type III	1800 km	FDM	0TLP	-13 dBm0	10 dBm0	Tactical Less Maneuverable System
Tactical Subsystem Type IV	1200 km	TDM/CVSD	Not Applicable	Not Applicable	Not Applicable	Not Applicable

Note 1: See figure 5-1.
Note 2: There is older FDM equipment still in inventory. This equipment has been classified as belonging to the tactical subsystem type II.
Note 3: Table 5-1 was extracted from MIL-STD-188-212 (table 3).
Legend:
CVSD - Continuously Variable Slope Delta
km - kilometers
PCM - Pulse Code Modulation
dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point
TDM - Time Division Multiplex
FDM - Frequency Division Multiplex
MIL-STD - Military Standard
TLP - Transmission Level Point



Note 1: The TLP are only internal references for each subsystem and cannot be transferred across the interface. (SEE NOTE 1 OF 5.3.2.1.2.)

Note 2: Figure 5-1 was extracted from MIL-STD-188-212 (figure 4).

Legend:

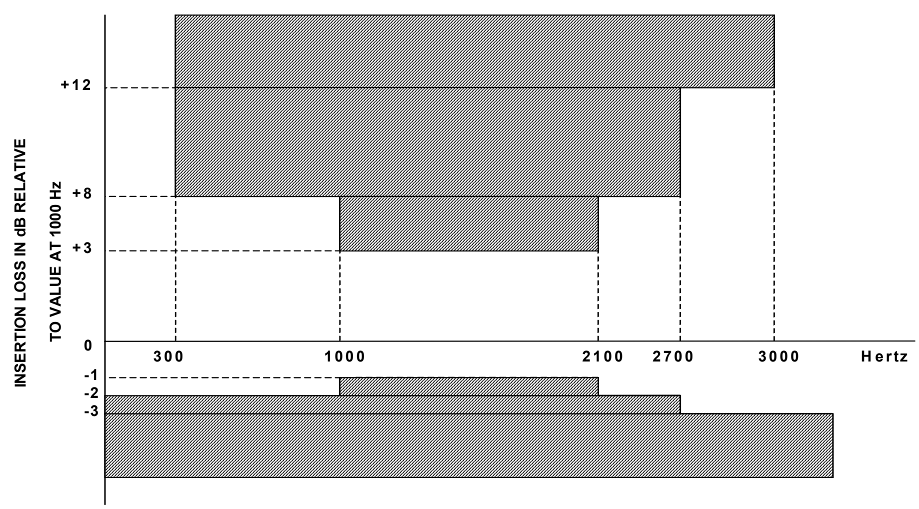
dB - decibels
dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point
dBm - dB referred to one milliwatt
VF - Voice Frequency

Figure 5-1. Signal Level and Interface Diagram for Connecting Voice Frequency (VF) Channels of Tactical Subsystems Type I or Type II with Type III

Table 5-2. Insertion Loss Versus Frequency Characteristics of VF Channels for Data Transmissions with Modulation Rates of 1200 Bd or Less

Frequency in Hz	Insertion Loss in dB (Referenced to 1000 Hz)
f < 300	≥ -2
300 ≤ f < 1000	-2 to +6
1000 ≤ f < 2400	-1 to +3
2400 ≤ f < 2700	-2 to +6
2700 ≤ f < 3000	-3 to +12
3000 ≤ f	≥ -3

Note: Table 5-2 was extracted from MIL-STD-188-212 (table 4).
Legend:
< - less than
≤ - less than or equal to
≥ - greater than or equal to
dB - decibels
f - frequency
Hz - hertz
MIL-STD - Military Standard



Note 1: Figure 5-2 was extracted from MIL-STD-188-212 (figure 3a).
Note 2: These upper and lower frequency limits are not specified.
Legend:
dB - decibels
MIL-STD - Military Standard
Hz - hertz

Figure 5-2. Insertion Loss Versus Frequency Characteristics

5-3 Test Procedures

a. Test Equipment Required

(1) UUT (2 ea)

(2) Attenuator

(3) Multifunction Synthesizer

(4) Audio Breakout Box

(5) Audio Analyzer

(6) Modem

(7) Fireberd

b. Test Configuration. Configure the equipment as shown in figures 5-3 and 5-4.

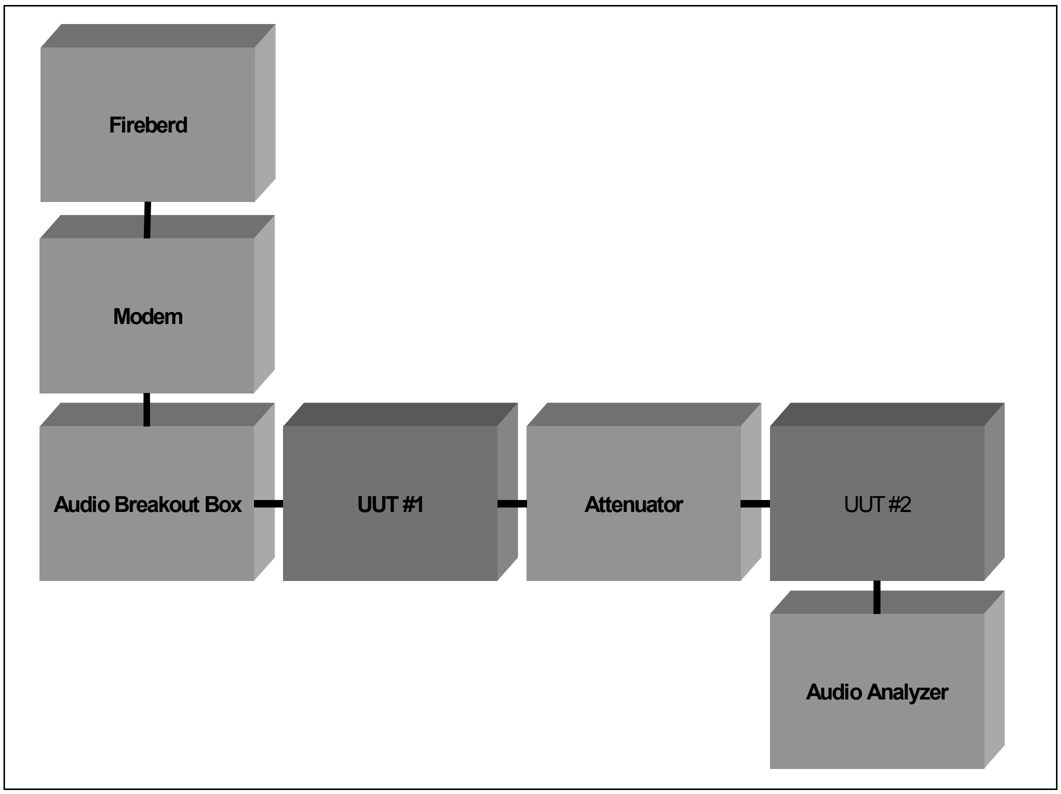


Figure 5-3. Transmitted Quasi-Analog Signal Level Test Equipment Configuration

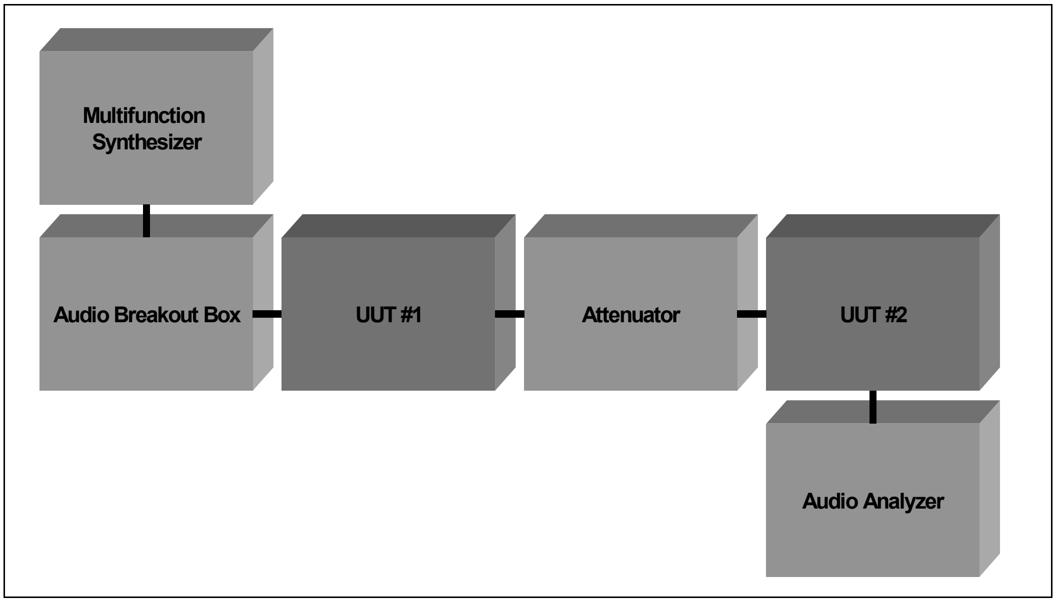


Figure 5-4. Insertion Loss Versus Frequency Characteristics Test Equipment Configuration

c. Test Conduct. Reference numbers 7 and 10 are tactical subsystems type I or type III. The test procedures are listed in tables 5-3 and 5-4.

Table 5-3. Quasi-Analog Signal Level Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference numbers 7 and 10.			
1	Configure equipment.	As shown in figure 5-3.	
2	Configure audio breakout box.	Check with manufacturer's specifications for modem pin out. Breakout box will be used as the UUT keyer.	
3	Configure UUT 1 and 2.	Frequency: 312.500 MHz Plain text, Single channel	
4	Configure audio analyzer.	No filter, ac level, volts, dB	
5	Configure Fireberd.	Data rate: 1:1 Synchronous Sync Frequency: 1.2 kHz Duration: Continuous	
6	Configure modem.	Carrier Frequency: 1800 Hz 1200 bps Mode: FSK Output Level: -13 dBm	

Table 5-3. Quasi-Analog Signal Level Test Procedures (continued)

Step	Action	Settings/Action	Result
7	Start the data pattern on the Fireberd.	Is a value of -13 dB ±0.5 dB displayed on the audio analyzer? Record measurement displayed on the audio analyzer.	Record measurement on data collection form and test results matrix.

Legend:
± - plus or minus
ac - alternating current
bps - bits per second
dB - decibels
dBm - dB referred to one milliwatt
FSK - Frequency Shift Keying
Hz - hertz
kHz - kilohertz
MHz - megahertz
UUT - Unit Under Test

Table 5-4. Insertion Loss Test Procedures

Step	Action	Settings/Action	Result
	The following procedures refer to reference number 16.		
1	Configure equipment.	As shown in figure 5-4.	
2	Configure audio breakout box.	Check with manufacturer's specifications for modem pin out. Breakout box will be used as the UUT keyer.	
3	Configure UUT 1 and 2.	Frequency: 312.500 MHz Plain text, Single channel	
4	Configure audio analyzer.	No filter, ac level, volts, dB	
5	Configure multifunction synthesizer.	Frequency: 1000 Hz (reference tone) Amplitude: Complete setup. Key UUT and adjust amplitude. Amplitude should be -13 dBm.	
6	Key breakout box.	Is a value of -13 dB, ±0.5 dB displayed on the audio analyzer? Record measurement displayed on the audio analyzer.	Record measurement on data collection and test results matrix.
7	Unkey breakout box.		
	The following procedures refer to reference number 18.		
8	Adjust audio tone to 300 Hz.	Key breakout box. Record audio levels at audio analyzer.	Record measurement on data collection and test results matrix.
9	Unkey breakout box.		
10	Repeat steps 8 through 9, adjusting the audio tone by 100-Hz increments until 3000 Hz is reached.	Record audio analyzer readings at each 100-Hz step on data collection form and test results matrix.	

Legend:
± - plus or minus
ac - alternating current
bps - bits per second
dB - decibels
dBm - dB referred to one milliwatt
Hz - hertz
kHz - kilohertz
MHz - megahertz
UUT - Unit Under Test

5-4 Presentation of Results. The results will be shown in table 5-5 indicating the requirement and measured value or indications of capability.

Table 5-5. Quasi-Analog Signal Level and Insertion Loss Test Results

Reference Number	MIL-STD Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
7	MIL-STD 188-212 5.2.8.2.2	The transmitted quasi-analog signal level at the modulator output shall be adjusted such that the signal level stated in 5.3.2.1.5 is obtained at the input of the VF channel of the transmission subsystem.	That the signal level stated in 5.3.2.1.5 is obtained at the input of the VF channel.			
10	MIL-STD 188-212 5.3.2.1.5	For the tactical subsystems type I and type III (See table 5-1), the quasi-analog signal level shall be -13 dBm0 (i.e., -13 dBm at a 0TLP) at the input terminals, and shall be -13 dBm0, at the output terminals of the FDM equipment of the transmission subsystem.	Be -13 dBm0.			
16	MIL-STD 188-212 5.3.2.2.3	The insertion loss of a VF channel shall be dB, ±0.5 dB, measured at 1000 Hz, ±25 Hz.	±0.5 dB, measured at 1000 Hz, ±25 Hz.			
18	MIL-STD 188-212 5.3.2.2.5	For data transmission with modulation rates of 1200 Bd or less over VF channels, the insertion loss versus frequency characteristic, referenced to 1000 Hz, shall not exceed the values given in table 5-1 over the frequency bands stated. Loss is indicated by a (+) and gain by a (-) sign (figure 5-1).	Shall not exceed the values given in table 5-1 over the frequency bands stated. Loss is indicated by a (+) and gain by a (-) sign (figure 5-1).			

Note: The parameter values listed in table 5-1are identical to the values for the D2 circuit parameters which are part of the DCS technical schedule published in DCAC 300-175-9. The DCS technical schedule is based on corresponding parameter values used by commercial carriers. The parameter values of the DCS technical schedule are considered to be the best information available to specify VF-channel characteristics necessary for acceptable data transmission. However, experience has shown that VF channels may provide acceptable data service when the measured parameters are close to, but not exactly within, the limits of the values listed in table 5-1 and 5-2. Therefore, the parameter values listed in these tables should not be used exclusively to determine the need for regenerating data signals and conditioning data channels.

Legend:

± - plus or minus
dBm - dB referred to one milliwatt
MIL-STD - Military Standard
Bd - baud
FDM - Frequency Division Multiplex
0TLP - Zero Transmission Level Point
dB - decibels
Hz - hertz
VF - Voice Frequency
dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point

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SUBTEST 6. CHANNEL NOISE POWER

6-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference number 11.

6-2 Criteria. Reference number 11. For the tactical subsystem type I and type III (table 6-1), the non-impulse type of the total channel noise power (consisting of multiplex idle channel noise, multiplex loaded channel noise, and transmission media noise) shall not exceed 50,000 picowatts, referenced to Zero Transmission Level Point (pW0) [47.0 decibels above reference noise, referenced to Zero Transmission Level Points (dBrn0)], when measured at or referenced to a 0TLP of the VF channel under consideration. For the tactical subsystem type II, the non-impulse type of the idle channel noise power shall not exceed 40,000 pW0 (46.0 dBrn0) when measured at or referenced to a 0TLP of the VF channel under consideration. The channel noise power shall be measured with flat weighting over the frequency band from 300 Hz to 3400 Hz.

Table 6-1. Switched Multichannel Communications Subsystems

MIL-STD-188-200 Terms	Probable Max Distance	Multiplexer Equipment	TLP	Quasi-Analog Signal Level (See Note 1)	Standard Test Tone Level (See Note 1)	MIL-STD-188-200 Terms
Tactical Subsystem Type I	300 km	FDM	0TLP	-13 dBm0	-10 dBm0	Tactical Highly Maneuverable System
Tactical Subsystem Type II	300 km	TDM/PCM	-4 TLP	-6 dBm0	-3 dBm0	
		FDM (See Note 2)	-4 TLP	-6 dBm0	-3 dBm0	
Tactical Subsystem Type III	1800 km	FDM	0TLP	-13 dBm0	13 dBm0	Tactical Less Maneuverable System
Tactical Subsystem Type IV	1200 km	TDM/CVSD	Not Applicable	Not Applicable	Not Applicable	Not Applicable

Note 1: See figure 6-1.
Note 2: There is older FDM equipment still in inventory. This equipment has been classified as belonging to the tactical subsystem type II.
Note 3: Table 6-1 was extracted from MIL-STD-188-212 (table 3).
Legend:
CVSD - Continuously Variable Slope Delta
dBm - dB referred to one milliwatt
FDM - Frequency Division Multiplex
km - kilometers
MIL-STD - Military Standard
PCM - Pulse Code Modulation
TDM - Time Division Multiplex
TLP - Transmission Level Point
0TLP - Zero Transmission Level Point

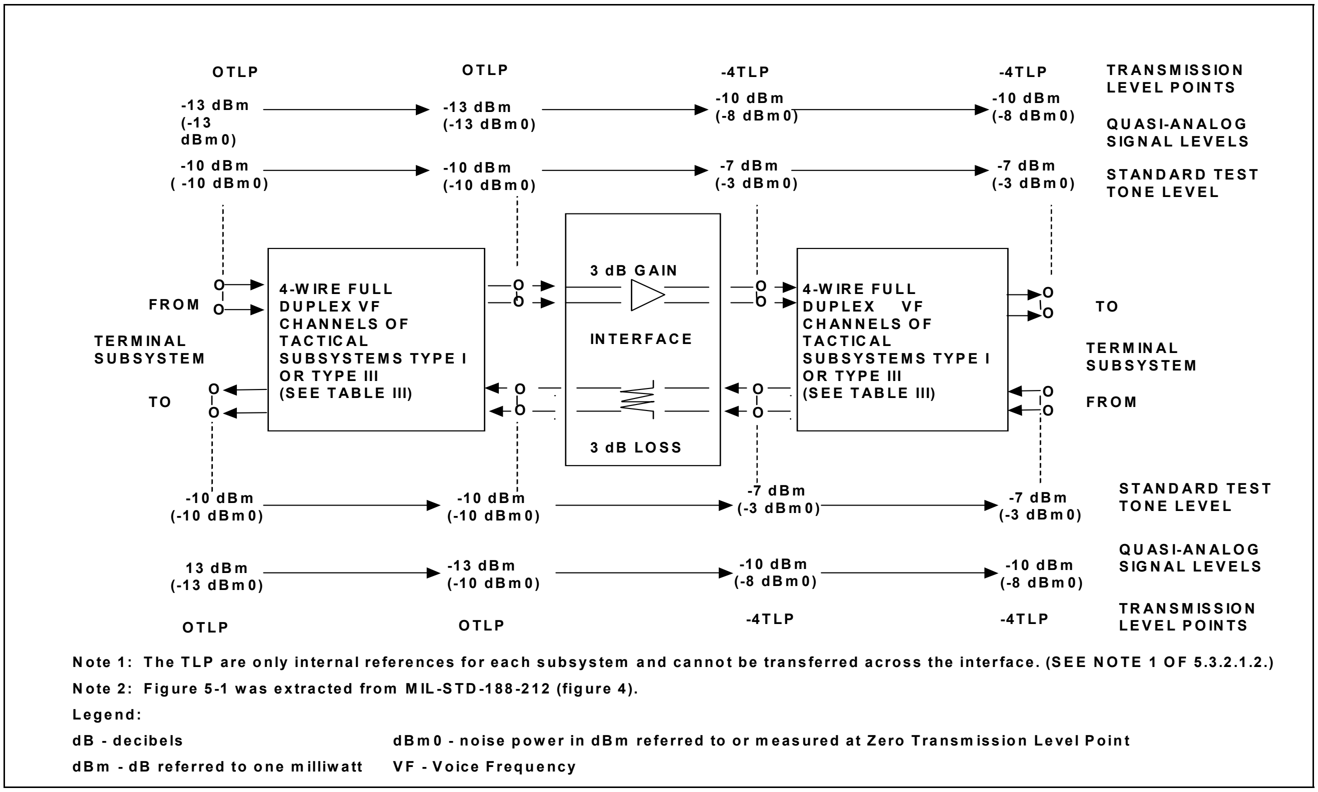

Figure 6-1. Signal Level and Interface Diagram for Connecting VF Channels of Tactical Subsystems Type I or Type II with Type III

6-3 Test Procedures

a. Test Equipment Required

(1) UUT

(2) Audio Breakout Box

(3) Spectrum Analyzer

b. Test Configuration. Configure the equipment as shown in figure 6-2.

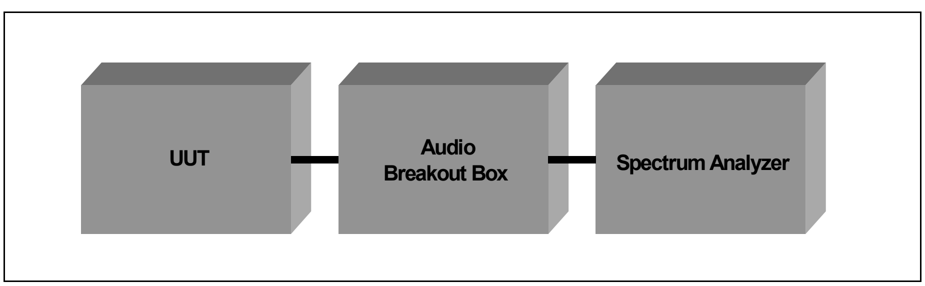

Figure 6-2. Channel Noise Power Test Equipment Configuration

c. Test Conduct. The test procedures are listed in table 6-2.

Table 6-2. Channel Noise Power Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 11.			
1	Configure equipment.	As shown in figure 6-2.	
2	Configure UUT.	Plain text; Single channel Squelch off Radio should be in an idle state so no frequency will be needed.	
3	Configure audio breakout box.	Refer to manufacturer's specification for correct pin out.	
4	Configure spectrum analyzer.	Center Frequency: 2.5 kHz Span: 5 kHz	
5	On the spectrum analyzer.	Select markers.	
6	On the spectrum analyzer.	Observe the channel noise power. Refer to step 7 or 8 depending on the type of tactical subsystem.	
7	Observe impulse noise for a period of 15 minutes on the spectrum analyzer for tactical subsystem type I.	Adjust markers from 300 Hz to 3400 Hz and observe the channel noise power does not exceed 50,000 pW0 (47.0 dBrn0).	Record measurements on data collection form and test results matrix.
8	Observe impulse noise for a period of 15 minutes on the spectrum analyzer for tactical subsystem type II.	Adjust markers from 300 Hz to 3400 Hz and observe the channel noise power does not exceed 40,000 pW0 (46.0 dBrn0).	Record measurements on data collection form and test results matrix.

Note: Sections that are not applicable to a particular step are shaded.
Legend:
dBrn0 - decibels above reference noise, referenced to Zero Transmission Level Point
Hz - hertz
kHz - kilohertz
pW0 - picowatt(s) referenced to Zero Transmission Level Points
UUT - Unit Under Test

6-4 Presentation of Results. The results will be shown in table 6-3 indicating the requirement and measured value or indications of capability.

Table 6.3. Channel Noise Power Test Results

Reference Number	MIL-STD Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
11	MIL-STD 188-212 5.3.2.1.6	For (table 6-1), the non-impulse type of the total channel noise power (consisting of multiplex idle channel noise, multiplex loaded channel noise and transmission media noise) shall not exceed 50,000 pW0 (47.0 dBrn0), when measured at or referenced to a 0TLP of the VF channel under consideration. For the tactical subsystem type II, the non-impulse type of the idle channel noise power shall not exceed 40,000 pW0 (46.0 dBrn0), when measured at or referenced to a 0TLP of the VF channel under consideration. The channel noise power shall be measured with flat weighting over the frequency band from 300 Hz to 3400 Hz.	The tactical subsystem type I and type III shall not exceed 50,000 pW0 (47.0 dBrn0).			
			The tactical subsystem type II, the non-impulse type of the idle channel noise power shall not exceed 40,000 pW0 (46.0 dBrn0).			
Legend: dBrn0 - decibels above reference noise, referenced to Zero Transmission Level Point Hz - hertz MIL-STD - Military Standard VF - Voice Frequency pW0 - picowatts; referenced to Zero Transmission Level Point 0TLP - Zero Transmission Level Point						

SUBTEST 7. SIGNAL-TO-NOISE RATIO AND AUDIO INPUT

7-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference number 12.

7-2 Criteria. Reference number 12. The root-mean-square (rms)-signal-to-rms-noise ratio shall be at least 26 dB for data transmission with modulation rate of 2400 Bd or less over VF channels. The parameter shall be measured at the quasi-analog output terminals of the transmission subsystem with flat weighting over the frequency band occupied by the quasi-analog signal.

7-3 Test Procedures

a. Test Equipment Required

(1) TIMS (2 ea)

(2) UUT (2 ea)

(3) Attenuator

(4) Audio Breakout Box (2 ea)

b. Test Configuration. Configure the equipment as shown in figure 7-1.

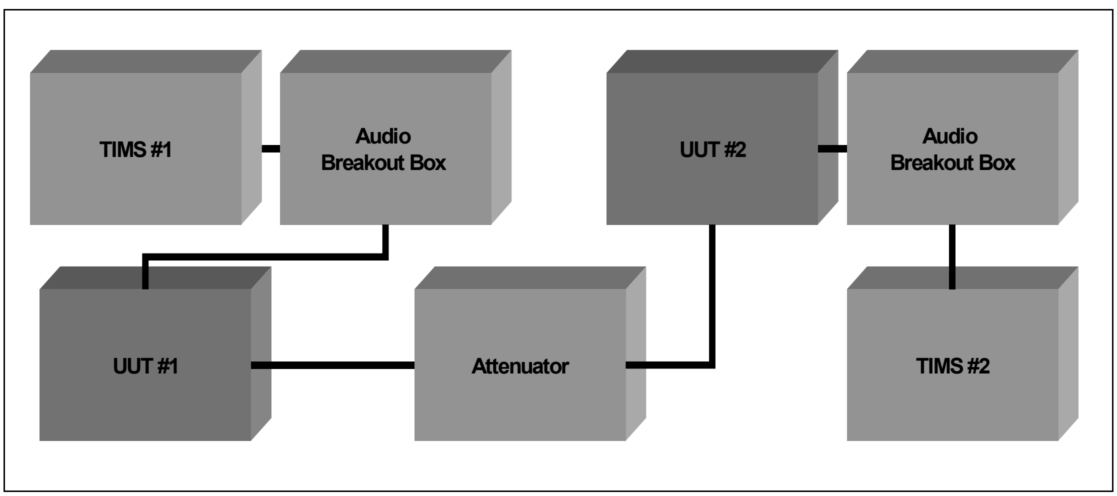

Figure 7-1. Signal-to-Noise Ratio Test Equipment Configuration

c. Test Conduct. The test procedures are listed in table 7-1.

Table 7-1. Signal-to-Noise Ratio and Audio Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 12.			
1	Configure equipment.	As shown in figure 7-1.	
2	Configure UUT 1 and 2.	Frequency: 312.500 MHz Plain text, Single channel	
3	Configure TIMS 1 and 2.	TIMS 1: Transmit Frequency: 1004 Hz Measurement: Signal to noise. No filter. TIMS 2. Receive Measurement: Signal to noise. No filter.	
4	Configure audio breakout boxes.	Check with manufacturer's specification for quasi-analog output terminal pins.	
5	Key UUT.	Record value displayed on TIMS 2 after 1 minute.	Record results on data collection form and test results matrix.
Legend: Hz - hertz MHz - megahertz TIMS - Transmission Impairment Measurement Set UUT - Unit Under Test			

7-4 Presentation of Results. The results will be shown in table 7-2 indicating the requirement and measured value or indications of capability.

Table 7-2. Signal-to-Noise Ratio and Audio Input Test Results

Reference Number	MIL-STD/ STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
12	MIL-STD 188-212 5.3.2.1.7	The rms-signal-to-rms-noise ratio shall be at least 26 dB for data transmission with modulation rate of 2400 Bd or less over VF channels. The parameter shall be measured at the quasi-analog output terminals of the transmission subsystem with flat weighting over the frequency band occupied by the quasi-analog signal.	26 dB for data transmission with modulation rate of 2400 Bd or less over VF channels.			
Note: The SNR rated in 5.3.2.1.7 is a necessary but not sufficient requirement for acceptable data transmission since signal discontinuities (See 5.3.2.3) may increase the BER for certain unpredictable periods of time. **Legend:** Bd - baud BER - Bit Error Rate dB - decibels dBm - dB referred to one milliwatt MIL-STD - Military Standard rms - root-mean-square SNR - Signal-to-Noise Ratio STANAG - Standardization Agreement VF - Voice Frequency						

SUBTEST 8. SIGNAL TONE INTERFERENCE

8-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference number 13.

8-2 Criteria. Reference number 13. No interfering single-frequency tone shall exceed 30 decibels above reference noise (dBrn) (DO: 24 dBrn), measured at the quasi-analog input terminals of the demodulator in the terminal subsystem with flat weighting over the frequency band from 300 Hz to 3400 Hz.

8-3 Test Procedures

a. Test Equipment Required

(1) TIMS (2 ea)

(2) UUT (2 ea)

(3) UUT Keyer

(4) Modulation Analyzer

(5) Audio Breakout box

b. Test Configuration. Configure the equipment as shown in figure 8-1.

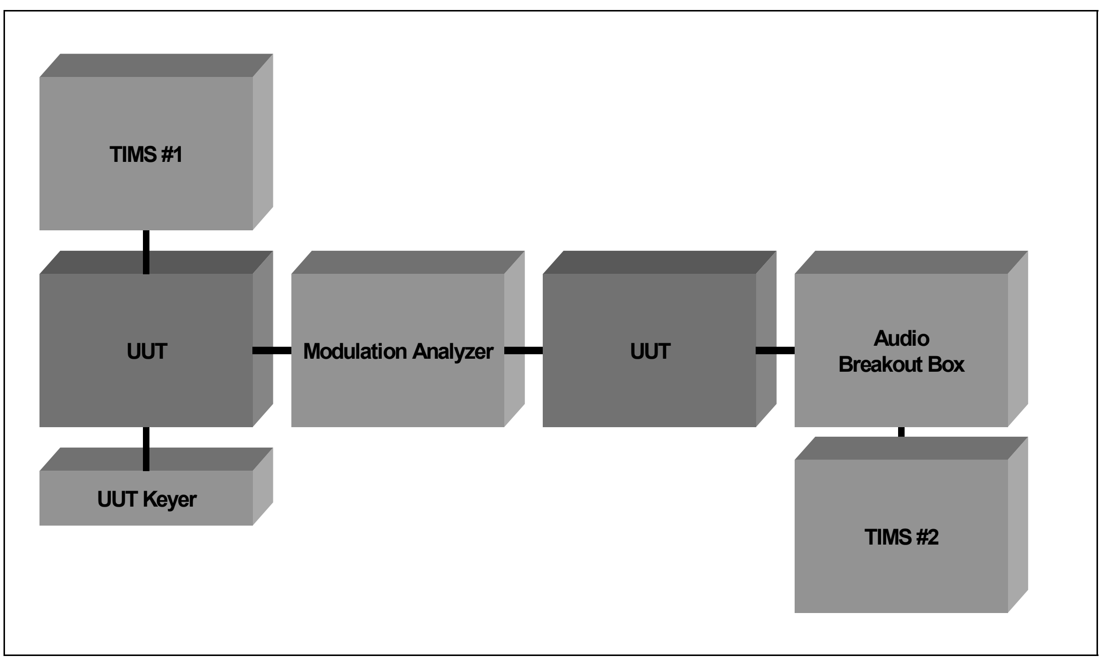

Figure 8-1. Signal Tone Interference Test Equipment Configuration

c. Test Conduct. The test procedures are listed in table 8-1.

Table 8-1. Signal Tone Interference Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 13.			
1	Configure equipment.	As shown in figure 8-1.	
2	Configure UUT 1 and 2.	Frequency: 312.500 MHz Plain text; Single channel	
3	Configure TIMS 1.	Tone: 300 Hz Transmit Set up: 600 ohms Measurement: Noise with tone. Filter: 3 kHz flat.	
4	Configure TIMS 2.	Receive Set up: 600 ohms Measurement: Noise with tone. Filter: 3 kHz flat.	
5	Configure modulation analyzer.	FM	
6	Configure audio breakout box.	Check with manufacturer's specification for the correct demodulator pins.	
7	Key UUT.	Record the interfering single-tone frequency displayed on TIMS 2.	Record measurement on data collection form and test results matrix.
8	Unkey UUT.		
9	Repeat steps 7 and 8, adjusting tones on TIMS 1 from 400 Hz to 3400 Hz in 100-Hz increments.	Record measurement at each 100-Hz step result from TIMS 2.	Record measurement on data collection form and test results matrix.
Legend: FM - Frequency Modulation Hz - hertz kHz - kilohertz TIMS - Transmission Impairment Measurement Set UUT - Unit Under Test			

8-4 Presentation of Results. The results will be shown in table 8-2 indicating the requirement and measured value or indications of capability.

Table 8-2. Signal Tone Interference Test Results

Reference Number	MIL-STD Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
13	MIL-STD 188-212 5.3.2.1.8	No interfering single-frequency tone shall exceed 30 dBrn (DO: 24 dBrn), measured at the quasi-analog input terminals of the demodulator in the terminal subsystem with flat weighting over the frequency band from 300 Hz to 3400 Hz.	30 dBrn			

Legend:
dBrn - decibels above reference noise
DO - Design Objective
Hz - hertz
MIL-STD - Military Standard

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SUBTEST 9. FREQUENCY ACCURACY, STABILITY, AND DEVIATION

9-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference number 14 and STANAG 5511, annex B, reference numbers 29, 32, and 40.

9-2 Criteria

a. Reference number 14. Any single-frequency signal transmitted over a VF channel shall be reproduced at the output terminals of this channel with a frequency error of not more than ±1 Hz for single links and not more than ±4 Hz for multiple links in tandem.

b. Reference number 29. The frequency translation introduced by any single link due to the difference in carrier frequencies at each end of the link shall not exceed 1.0 Hz.

c. Reference number 32. After an initial warm-up period not exceeding 5 minutes, the deviation from the selected carrier frequency in the absence of modulation shall not exceed ± 2.5 kHz.

d. Reference number 40. The accuracy of any selected carrier frequency shall not vary more than ± 5 parts in 1,000,000 for a period of 6 months after a warm-up period of 30 minutes under any combination of specified service condition. An adjustment control shall be provided to permit the equipment to be periodically calibrated or aligned to within one part in 10,000,000 of the designated frequency.

9-3 Test Procedures

a. Test Equipment Required

(1) UUT (2 ea)

(2) Attenuator (2 ea)

(3) Universal Counter (2 ea)

(4) Modulation Analyzer

(5) Audio Generator

(6) Audio Breakout Box

(7) 600-Ohm Load

b. Test Configuration. Configure the equipment as shown in figures 9-1, 9-2, 9-3, and 9-4.

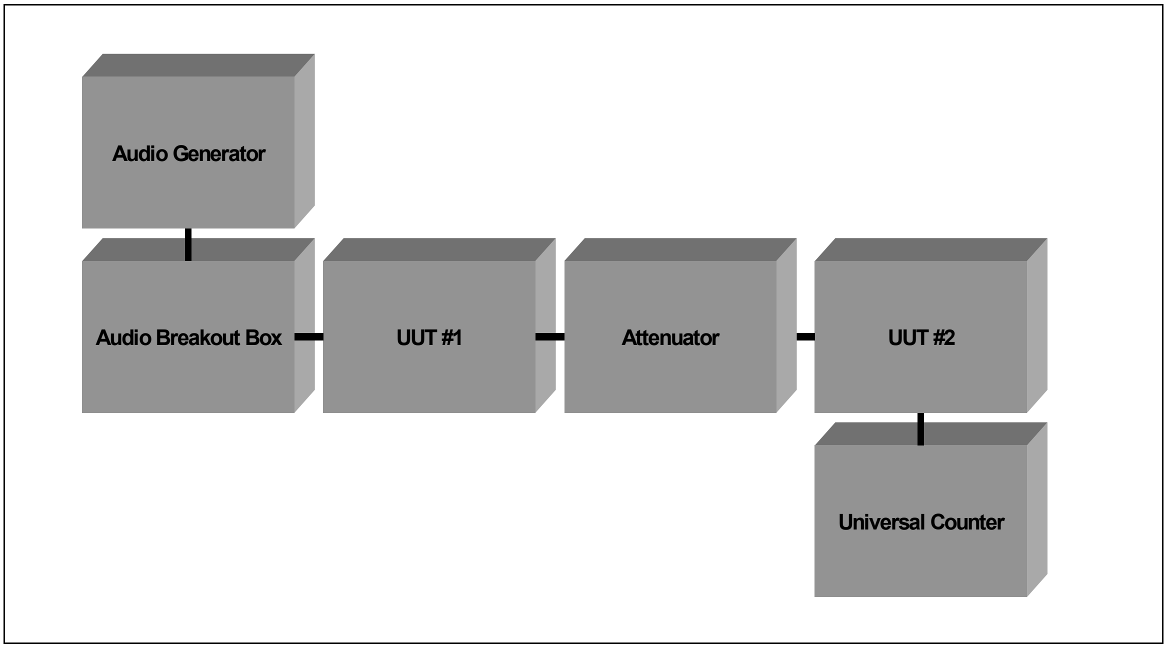

Figure 9-1. Frequency Stability Test Equipment Configuration

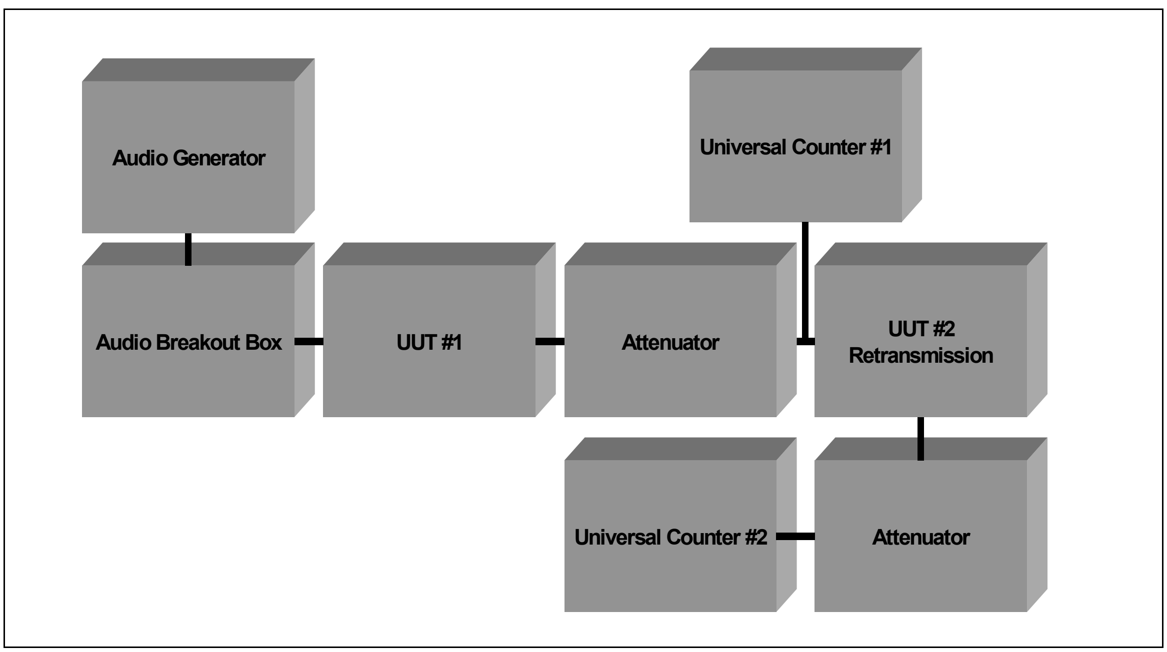

Figure 9-2. Frequency Stability with Retransmission Unit Under Test (UUT) Test Equipment Configuration

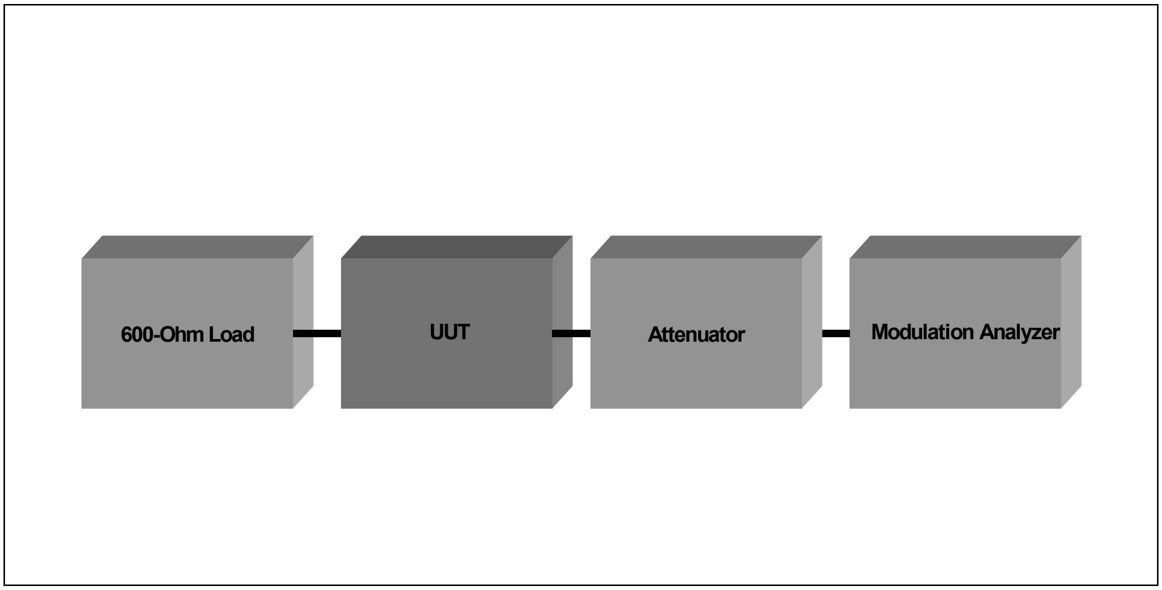

Figure 9-3. Frequency Deviation Test Equipment Configuration

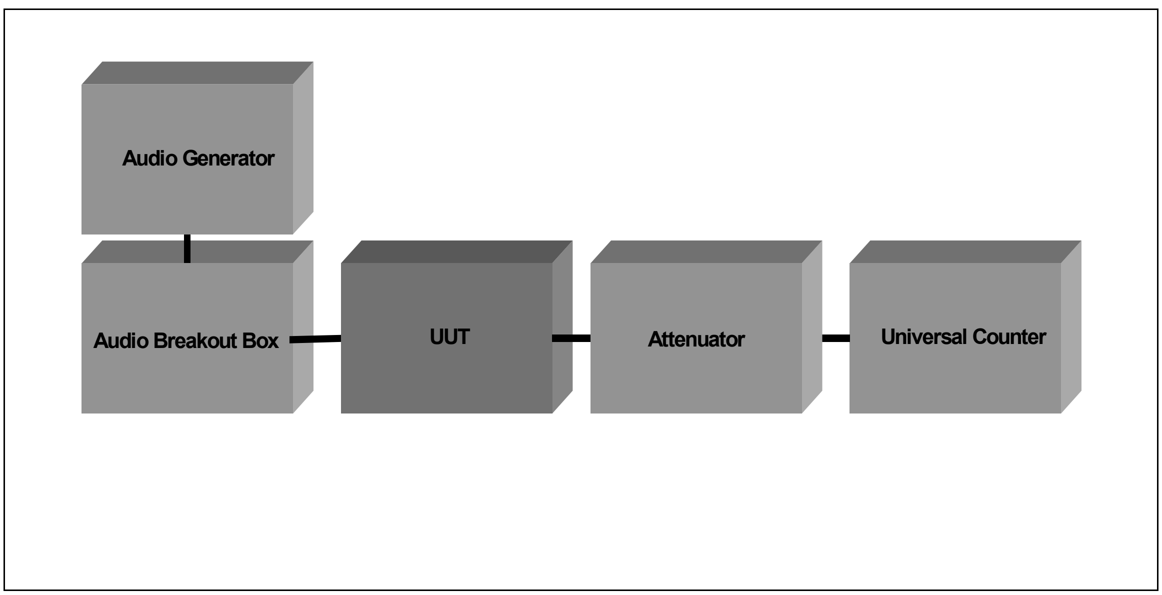

Figure 9-4. UHF Accuracy and Stability Test Equipment Configuration

c. Test Conduct. The test procedures are listed in tables 9-1, 9-2, 9-3, and 9-4.

Table 9-1. Frequency Stability Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 14.			
1	Configure equipment.	As shown in figure 9-1.	
2	Configure UUT 1 and 2.	Frequency: 225.000 MHz Plain text; Single channel	
3	Configure audio generator.	Tone: 1004 Hz Amplitude: 2.2 Vpp Waveform: Sine	
4	Configure audio breakout box.	Check with manufacturer's specifications for correct audio pins.	
5	Configure universal counter.	Gate: 100 Channel: 3	
6	Key breakout box.		
7	On universal counter display.	Record frequency error.	Record measurement on data collection form and test results matrix.
8	Unkey audio breakout box.	Change frequency on UUT to 242.500 MHz.	
9	Key audio breakout box.	Record frequency error.	Record measurement on data collection form and test results matrix.
10	Unkey audio breakout box.	Change frequency on UUT to 260.000 MHz.	
11	Key audio breakout box.	Record frequency error.	Record measurement on data collection form and test results matrix.
12	Unkey audio breakout box.	Change frequency on UUT to 277.500 MHz.	
13	Key audio breakout box.	Record frequency error.	Record measurement on data collection form and test results matrix.
14	Unkey audio breakout box.	Change frequency on UUT to 295.000 MHz.	
15	Key audio breakout box.	Record frequency error.	Record measurement on data collection form and test results matrix.
16	Unkey audio breakout box.	Change frequency on UUT to 312.500 MHz.	

Table 9-1. Frequency Stability Test Procedures (continued)

Step	Action	Settings/Action	Result
17	Key audio breakout box.	Record frequency error.	Record measurement on data collection form and test results matrix.
18	Unkey audio breakout box.	Change frequency on UUT to 330.000 MHz.	
19	Key audio breakout box.	Record frequency error.	Record measurement on data collection form and test results matrix.
20	Unkey audio breakout box.	Change frequency on UUT to 365.000 MHz.	
21	Key audio breakout box.	Record frequency error.	Record measurement on data collection form and test results matrix.
22	Unkey audio breakout box.	Change frequency on UUT to 382.500 MHz.	
23	Key audio breakout box.	Record frequency error.	Record measurement on data collection form and test results matrix.
24	Unkey audio breakout box.	Change frequency on UUT to 400.000 MHz.	
25	Key audio breakout box.	Record frequency error.	Record measurement on data collection form and test results matrix.
Note: Sections that not applicable to a particular step are shaded. **Legend:** ± - plus or minus MHz - megahertz Vpp - volts peak to peak Hz - hertz UUT - Unit Under Test			

Table 9-2. Frequency Stability with Retransmission UUT Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 29.			
1	Configure equipment.	As shown in figure 9-2.	
2	Configure UUT 1.	Frequency: 225.000 MHz Plain text; Single channel	
3	Configure UUT 2.	Frequency: 225.000 MHz Plain text; Single channel Set in retransmission mode.	
4	Configure audio generator.	Tone: 1004 Hz Amplitude: 100 mV Waveform: Sine	

Table 9-2. Frequency Stability With Retransmission UUT Test Procedures (continued)

Step	Action	Settings/Action	Result
5	Configure audio breakout box.	Check with manufacturer's specifications for correct audio pins.	
6	Configure universal counter.	Gate: 100 Channel: 3	
7	Key breakout box.		
8	On universal counter display.	Record the difference in frequency error between universal counter 1 and 2. Unkey audio breakout box.	Record measurement on data collection form and test results matrix.
9	Unkey audio breakout box.	Change frequency on UUT to 242.500 MHz.	
10	Key audio breakout box.	Record the difference in frequency error between universal counter 1 and 2. Unkey audio breakout box.	Record measurement on data collection form and test results matrix.
11	Unkey audio breakout box.	Change frequency on UUT to 260.000 MHz.	
12	Key audio breakout box.	Record the difference in frequency error between universal counter 1 and 2. Unkey audio breakout box.	Record measurement on data collection form and test results matrix.
13	Unkey audio breakout box.	Change frequency on UUT to 277.500 MHz.	
14	Key audio breakout box.	Record the difference in frequency error between universal counter 1 and 2. Unkey audio breakout box.	Record measurement on data collection form and test results matrix.
15	Unkey audio breakout box.	Change frequency on UUT to 295.000 MHz.	
16	Key audio breakout box.	Record the difference in frequency error between universal counter 1 and 2. Unkey audio breakout box.	Record measurement on data collection form and test results matrix.
17	Unkey audio breakout box.	Change frequency on UUT to 312.500 MHz.	
18	Key audio breakout box.	Record the difference in frequency error between universal counter 1 and 2. Unkey audio breakout box.	Record measurement on data collection form and test results matrix.
19	Unkey audio breakout box.	Change frequency on UUT to 330.000 MHz.	

Table 9-2. Frequency Stability With Retransmission UUT Test Procedures (continued)

Step	Action	Settings/Action	Result
20	Key audio breakout box.	Record the difference in frequency error between universal counter 1 and 2. Unkey audio breakout box.	Record measurement on data collection form and test results matrix.
21	Unkey audio breakout box.	Change frequency on UUT to 365.000 MHz.	
22	Key audio breakout box.	Record the difference in frequency error between universal counter 1 and 2. Unkey audio breakout box.	Record measurement on data collection form and test results matrix.
23	Unkey audio breakout box.	Change frequency on UUT to 382.500 MHz.	
24	Key audio breakout box.	Record the difference in frequency error between universal counter 1 and 2. Unkey audio breakout box.	Record measurement on data collection form and test results matrix.
25	Unkey audio breakout box.	Change frequency on UUT to 400.000 MHz.	
26	Key audio breakout box.	Record the difference in frequency error between universal counter 1 and 2. Unkey audio breakout box.	Record measurement on data collection form and test results matrix.
Legend: Hz - hertz MHz - megahertz	mV - millivolts UUT - Unit Under Test		

Table 9-3. Frequency Deviation Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 32.			
1	Configure equipment.	As shown in figure 9-3.	
2	Configure UUT.	Frequency: 225.000 MHz Plain text; Single channel	
3	Configure audio breakout box.	Check with manufacturer's specifications for correct audio pins.	
4	Configure modulation analyzer.	FM deviation.	
5	During the initial warm-up period, not exceeding 5 minutes, check modulation analyzer display for deviation while radio is keyed.	Record deviation results from modulation analyzer.	Record measurement on data collection form and test results matrix.
Legend: FM - Frequency Modulation	MHz - megahertz	UUT - Unit Under Test	

Table 9-4. UHF Accuracy and Stability Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 40.			
1	Configure equipment.	As shown in figure 9-4.	
2	Configure audio generator.	Frequency: 1004 Hz	
3	Configure audio breakout box.	Refer to manufacturer's specification for correct pin outs.	
4	Configure UUT.	Frequency: 225.000 MHz Plain text, Single channel	
5	Configure universal counter.	Gate: 100 Channel: 3	
6	Key UUT.	Record frequency from universal counter.	Record measurement on data collection form and test results matrix.
7	Unkey UUT.	Change frequency on UUT to 242.500 MHz.	
8	Key UUT.	Record frequency from universal counter.	Record measurement on data collection form and test results matrix.
9	Unkey UUT.	Change frequency on UUT to 260.000 MHz.	
10	Key UUT.	Record frequency from universal counter.	Record measurement on data collection form and test results matrix.
11	Unkey UUT.	Change frequency on UUT to 277.500 MHz.	
12	Key UUT.	Record frequency from universal counter.	Record measurement on data collection form and test results matrix.
13	Unkey UUT.	Change frequency on UUT to 295.000 MHz.	
14	Key UUT.	Record frequency from universal counter.	Record measurement on data collection form and test results matrix.
15	Unkey UUT.	Change frequency on UUT to 312.500 MHz.	
16	Key UUT.	Record frequency from universal counter.	Record measurement on data collection form and test results matrix.
17	Unkey UUT.	Change frequency on UUT to 330.000 MHz.	

Table 9-4. UHF Accuracy and Stability Test Procedures (continued)

Step	Action	Settings/Action	Result
18	Key UUT.	Record frequency from universal counter.	Record measurement on data collection form and test results matrix.
19	Unkey UUT.	Change frequency on UUT to 365.000 MHz.	
20	Key UUT.	Record frequency from universal counter.	Record measurement on data collection form and test results matrix.
21	Unkey UUT.	Change frequency on UUT to 382.500 MHz.	
22	Key UUT.	Record frequency from universal counter.	Record measurement on data collection form and test results matrix.
23	Unkey UUT.	Change frequency on UUT to 400.000 MHz.	
24	Key UUT.	Record frequency from universal counter.	Record measurement on data collection form and test results matrix.
25	Unkey UUT. Repeat the steps in table 9-4 after a 6-month period.	Record results. Does the frequency vary more than ± 5 parts in 1,000,000 from the initial data collected?	Not testable

Legend:
Hz - hertz MHz - megahertz UUT - Unit Under Test

9-4 Presentation of Results. The results will be shown in table 9-5 indicating the requirement and measured value or indications of capability.

Table 9-5. Frequency Stability, Ultra High Frequency (UHF) Accuracy, and Stability Test Results

Reference Number	MIL-STD/ STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
14	MIL-STD 188-212 5.3.2.1.9	Any single-frequency signal transmitted over a VF channel shall be reproduced at the output terminals of this channel with a frequency error of not more than ±1 Hz for single links and not more than ±4 Hz for multiple links in tandem.	±1 Hz for single links and not more than ±4 Hz for multiple links in tandem.			
29	STANAG 5511 annex B 2.2.1.g	The frequency translation introduced by any single link due to the difference in carrier frequencies at each end of the link shall not exceed 1.0 Hz.	Shall not exceed 1.0 Hz.			
32	STANAG 5511 annex B 7.3.d	After an initial warm-up period not exceeding 5 minutes, the deviation from the selected carrier frequency in the absence of modulation shall not exceed ± 2.5 kHz.	Less than ± 2.5 kHz.			
40	STANAG 5511 annex B 7.5	The accuracy of any selected carrier frequency shall not vary more than ± 5 parts in 1,000,000 for a period of 6 months after a warm period of 30 minutes under any combination of specified service condition. An adjustment control shall be provided to permit the equipment to be periodically calibrated or aligned to within one part in 10,000,000 of the designated frequency.	± 5 parts in 1,000,000	Not testable		

Legend:
± - plus or minus
Hz - hertz
kHz - kilohertz
MIL-STD - Military Standard
STANAG - Standardization Agreement
VF - Voice Frequency

SUBTEST 10. CHARACTER-COUNT AND BIT-COUNT INTEGRITY

10-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference number 15.

10-2 Criteria. Reference number 15. No extraneous characters or bits (See Note in table 10-2) shall be inserted or deleted in message text. This requirement shall apply to all modulation and data signaling rates. The mean-time-between-losses of character-count and bit-count integrity shall be not less than 24 hours, measured from the data source of the transmitting terminal subsystem to the data link of the receiving terminal subsystem.

10-3 Test Procedures

a. Test Equipment Required

(1) Fireberd (2 ea)

(2) Modem (2 ea)

(3) UUT (2 ea)

(4) Attenuator

b. Test Configuration. Configure the equipment as shown in figure 10-1.

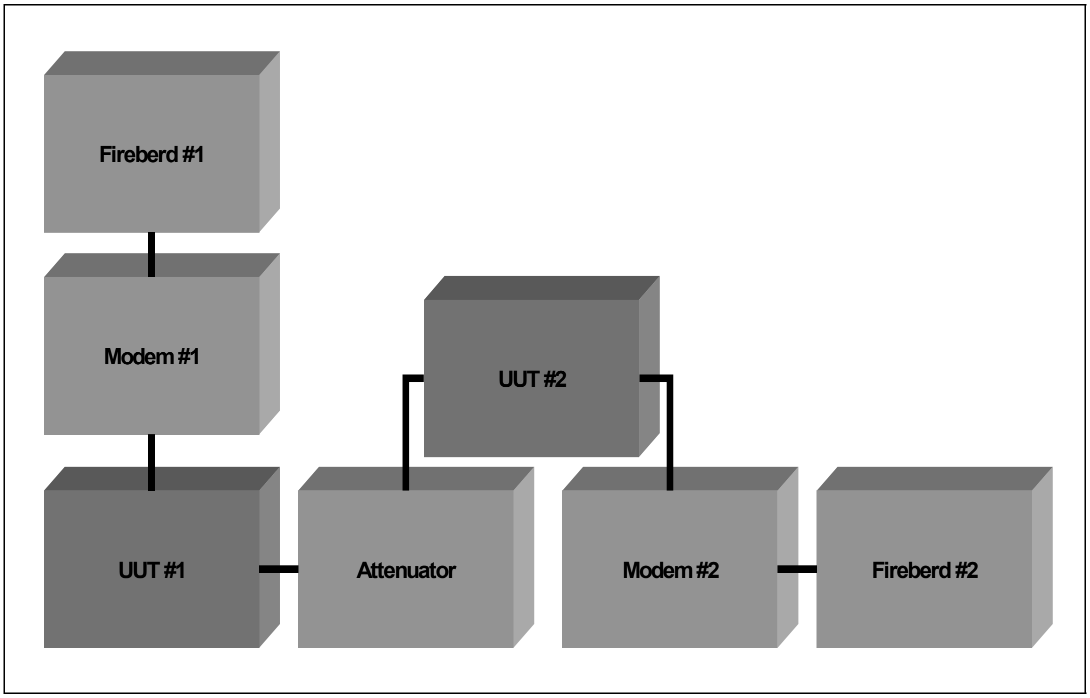

Figure 10-1. Character-Count and Bit-Count Integrity/RMS Level Test Equipment Configuration

c. Test Conduct. The test procedures are listed in table 10-1.

Table 10-1. Character-Count and Bit-Count Integrity Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 15.			
1	Configure equipment.	As shown in figure 10-1.	
2	Configure Fireberd 1 and 2.	Data pattern: 1:1 Timing mode to sync. Test interval to 24 hours. Error to BER. Show elapsed time.	
3	Configure modem 1 and 2.	TADIL B mode 600 bps 0 dBm rate	
4	Select run on Fireberd 1.	Run test for a 24-hour period.	
5	Check Fireberd 6000.	Record any inserted or deleted bits in a completed 24-hour test from Fireberd 2.	Record measurement on data collection form and test results matrix.
6	Change settings on modem 1 and 2 to 1200 bps. Reset Fireberd 1 and 2 for 24-hour test.	Record any inserted or deleted bits in a completed 24-hour test from Fireberd 2.	Record measurement on data collection form and test results matrix.

Table 10-1. Character-Count and Bit-Count Integrity Test Procedures (continued)

Step	Action	Settings/Action	Result
7	Change settings on modem 1 and 2 to 2400 bps. Reset Fireberd 1 and 2 for 24-hour test.	Record any inserted or deleted bits in a completed 24-hour test from Fireberd 2.	Record measurement on data collection form and test results matrix.
Legend: BER - Bit Error Rate bps - bits per second	dBm - dB referred to one milliwatt sync - synchronous	TADIL - Tactical Digital Information Link	

10-4 Presentation of Results. The results will be shown in table 10-2 indicating the requirement and measured value or indications of capability.

Table 10-2. Character-Count and Bit-Count Integrity Test Results

Reference Number	MIL-STD Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
15	MIL-STD 188-212 5.3.2.2.2	No extraneous characters of bits (See Note) shall be inserted or deleted in message texts. This requirement shall apply to all modulation and data signaling rates. The mean-time-between-losses of character-count and bit-count integrity shall be not less than 24 hours, measured from the data source of the transmitting terminal subsystem to the data link of the receiving terminal subsystem.	No extraneous characters of bits (See Note) shall be inserted or deleted in message texts.			
			600 bps			
			1200 bps			
			2400 bps			
			The mean-time-between-losses of character-count and bit-count integrity shall be not less than 24 hours.			

Note: Extraneous characters or bits include time differential blanks associated with asynchronous/synchronous transmission equipment. These characters or bits are permissible in the transmission subsystem if they can be recovered prior to forwarding the signal to the user interface device.
Legend:
bps - bits per second MIL-STD - Military Standard

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SUBTEST 11. NET LOSS VARIATION

11-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference number 17.

11-2 Criteria. Reference number 17. The net loss variation of a VF channel shall not exceed ±1 dB over any 15 consecutive minutes and ±5 dB over any 30 consecutive days.

Note: The above values do not account for net loss variations of unprotected field wire. Net losses of unprotected field wire may vary up to 0.7 dB/kilometer (km) between wet and dry weather conditions.

11-3 Test Procedures

a. Test Equipment Required

(1) Audio Generator

(2) Audio Breakout Box (2 ea)

(3) UUT (2 ea)

(4) Attenuator

(5) Audio Analyzer

b. Test Configuration. Configure the equipment as shown in figure 11-1.

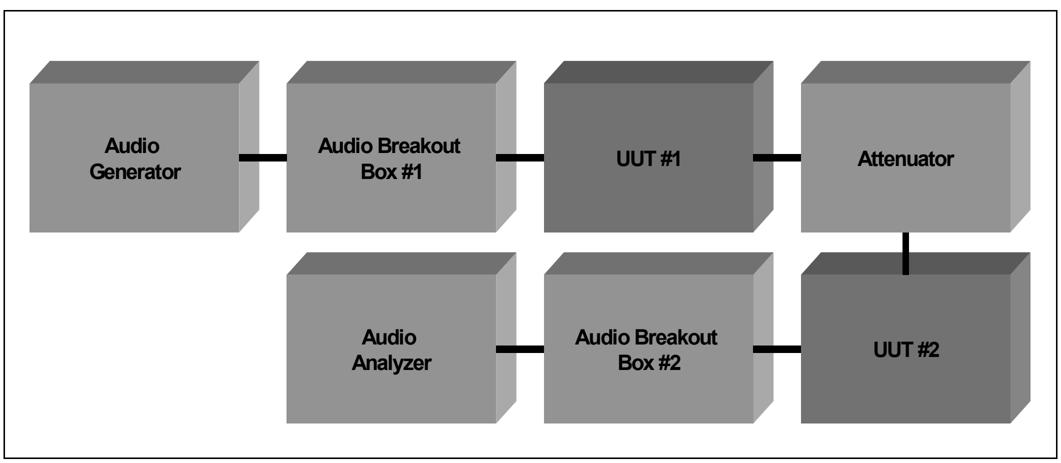


Figure 11-1. Net Loss Variation Test Equipment Configuration

c. Test Conduct. The criteria listed in MIL-STD 188-212, paragraph 5.3.2.2.4 states test will be conducted over a consecutive 30-day period. Confirm the transmitting limits of the UUT with the manufacturer before testing. Test procedures are listed in table 11-1.

Table 11-1. Net Loss Variation Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 17.			
1	Configure equipment.	As shown in figure 11-1.	
2	Configure audio generator.	Frequency: 1000 Hz	
3	Configure UUT.	Frequency: 312.500 MHz Plain text, Single channel	
4	Configure audio generator.	Audio generator 1 Transmit Frequency: 1004 Hz -13 dB level	
5	Configure audio analyzer.	Measurement: SINAD Low pass filter: 30 kHz	
6	Configure audio breakout box 1 and 2.	Refer to manufacturer's specification to the correct modem output UUT 1 and 2.	
7	Key UUT.	Record the level in dB periodically over a 15-minute period. Has the dB level exceeded $\pm$1 dB over 15 consecutive minutes?	Record periodic dB levels on data collection form.
8	Proceed to conduct test for 30 consecutive days.	Record the level in dB daily. Has the dB level exceeded $\pm$5 dB over 30 consecutive days?	Record periodic dB levels on data collection form.
Legend: $\pm$ - plus or minus db - decibels Hz - hertz kHz - kilohertz MHz - megahertz SINAD - Signal-Plus-Noise-Plus-Distortion to Noise-Plus-Distortion Ratio UUT - Unit Under Test			

11-4 Presentation of Results. The results will be shown in table 11-2 indicating the requirement and measured value or indications of capability.

Table 11-2. Net Loss Variation Test Results

Reference Number	MIL-STD Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
17	MIL-STD 188-212 5.3.2.2.4	The net loss variation of a VF channel shall not exceed $\pm$1 dB over any 15 consecutive minutes, and $\pm$5 dB over any 30 consecutive days.	$\pm$1 dB over any 15 consecutive minutes.			
			$\pm$5 dB over any 30 consecutive days.			
Note: The above values do not account for net loss variations of unprotected field wire. Net losses of unprotected field wire may vary up to 0.7 dB/km between wet and dry weather conditions. **Legend:** dB - decibels km - kilometer VF - Voice Frequency						

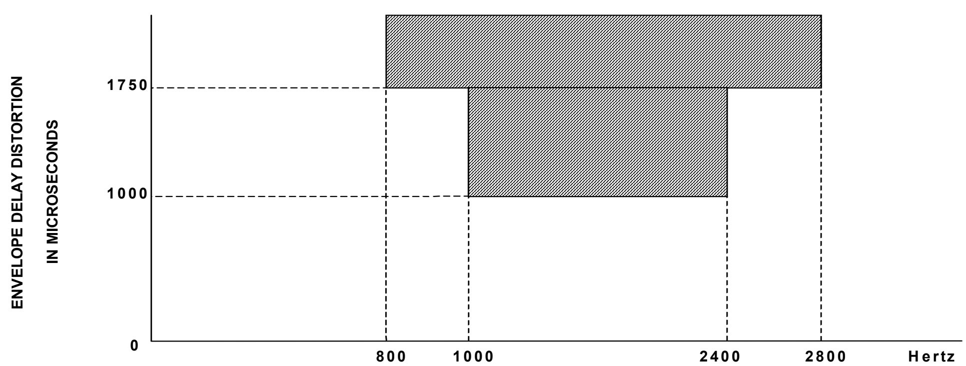
SUBTEST 12. ENVELOPE DELAY DISTORTION

12-1 Objective To determine the extent of compliance to the requirements of MIL-STD-188-212, reference number 19 and STANAG 5511, annex B, reference number 26.

12-2 Criteria

a. Reference number 19. For data transmission with modulation rates of 1200 Bd or less over VF channels, the envelope delay distortion, measured between 800 Hz and 2600 Hz, shall not exceed the values given in table 12-1 over the frequency bands stated (figure 12-1).

b. Reference number 26. The delay distortion in the frequency band between 600 and 2700 Hz shall not exceed 300 microseconds and in the frequency band between 1000 and 2500 Hz shall not exceed 200 microseconds.



Note: Figure 12-1 was extracted from MIL-STD-188-212 (figure 3B).

Figure 12-1. Envelope Delay Distortion

Table 12-1. Envelope Delay Distortion of VF Channel for Data Transmission with Modulation Rates of 1200 Bd or Less

Frequency in Hz	Maximum Envelope Delay Distortion in Microseconds
800 ≤ f < 1000	1750
1000 ≤ f < 2400	1000
2400 ≤ f ≤ 2600	1750

Note 1: Table 12-1 was extracted from MIL-STD-188-212 (table 5).
Legend:
≤ - less than or equal to
f - frequency
Hz - hertz
MIL-STD - Military Standard
VF - Voice Frequency

12-3 Test Procedures

a. Test Equipment Required

(1) Audio Generator

(2) UUT (2 ea)

(3) Attenuator

(4) 2 Channel Oscilloscope

b. Test Configuration. Configure the equipment as shown in figure 12-2.

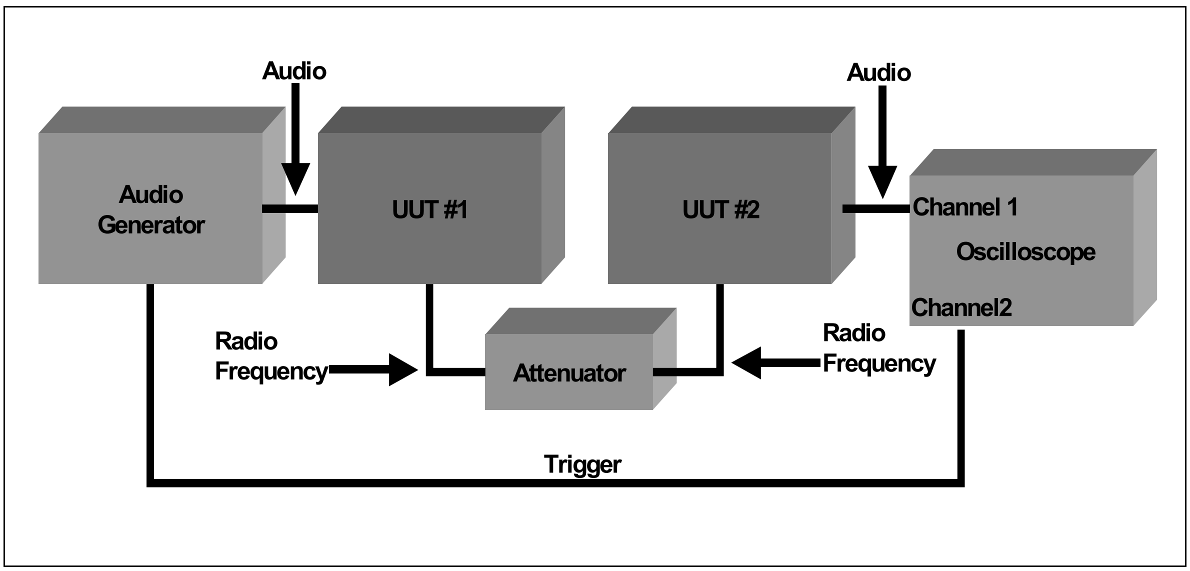


Figure 12-2. Envelope Delay Distortion Test Equipment Configuration

c. Test Conduct. The test procedures are listed in tables 12-2 and 12-3.

Table 12-2. Envelope Delay Distortion Transmit Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 19.			
1	Configure equipment.	See figure 12-2.	
2	Configure UUT 1 and 2.	Frequency: 312.500 MHz Plain text, Single channel	

Table 12-2. Envelope Delay Distortion Transmit Test Procedures (continued)

Step	Action	Settings/Action	Result
3	Configure audio generator.	Frequency: 800 Hz Level: Drive transmitter to full rated PEP.	
4	Configure oscilloscope.	Set Horizontal Scale to 5 msec/div. Set Vertical Scale to 0.5 V/div. Set Trigger to single sweep, channel 2. Set level to trigger when AF output on audio generator is toggled ON/OFF.	
5	Set AF output to the off position on the audio generator.		
6	Select RUN on oscilloscope.		
7	Key transmitter.		
8	Turn audio generator AF output ON.	Capture transmitter time delay.	
9	Measure envelope delay distortion.	Record results.	Record measurement on data collection form and test results matrix.
10	Increase the frequency of the audio generator in 100-Hz steps until 2600 Hz is reached, while repeating steps 3 through 9.		Record measurement on data collection form and test results matrix.

Legend:
AF - Audio Frequency; msec/div - millisecond per division; V/div - volt per division
Hz - hertz; PEP - Peak Envelope Power
MHz - megahertz; UUT - Unit Under Test

Table 12-3. Receiver Time Delay Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 26.			
1	Connect the equipment.	As shown in figure 12-3.	
2	Configure UUT 1 and 2.	Frequency: 312.500 MHz Plain text, Single channel	
3	Configure signal generator.	Frequency: 312.500 MHz	
4	Configure oscilloscope.	Set Horizontal Scale to 5 msec/div. Set Vertical Scale to 0.5 V/div. Set Trigger to single sweep, channel 2. Set level to trigger when AF output on audio generator is toggled ON/OFF.	

Table 12-3. Receiver Time Delay Test Procedures (continued)

Step	Action	Settings/Action	Result
5	Measure the delay distortion from 600 Hz to 900 Hz and 2500 Hz to 2700 Hz in 100-Hz steps.	Does delay distortion exceed 300 microseconds? Record results.	Record measurement on data collection form and test results matrix.
6	Measure the delay distortion from 1000 Hz to 2400 Hz.	Does delay distortion exceed 200 microseconds? Record results.	Record measurement on data collection form and test results matrix.

Legend:
AF - Audio Frequency
Hz - hertz
MHz - megahertz
msec/div - millisecond per division
UUT - Unit Under Test
V/div - volt per division

12-4 Presentation of Results. The results will be shown in table 12-4 indicating the requirement and measured value or indications of capability.

Table 12-4. Envelope Delay Distortion Test Results

Reference Number	MIL-STD/ STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
19	MIL-STD 188-212 5.3.2.2.6	For data transmission with modulation rates of 1200 Bd or less over VF channels, the envelope delay distortion, measured between 800 Hz and 2600 Hz, shall not exceed the values given in table 12-1 over the frequency bands stated.	800 Hz and 2600 Hz, shall not exceed the values given in table 12-1 over the frequency bands stated.			
26	STANAG 5511 annex B 2.2.1.d	The delay distortion in the frequency band between 600 and 2700 Hz shall not exceed 300 microseconds and in the frequency band between 1000 and 2500 Hz shall not exceed 200 microseconds.	600 and 2700 Hz shall not exceed 300 microseconds.			
			1000 and 2500 Hz shall not exceed 200 microseconds.			

Legend:
Bd - baud
Hz - hertz
MIL-STD - Military Standard
STANAG - Standardization Agreement
VF - Voice Frequency

SUBTEST 13. TOTAL HARMONIC DISTORTION

13-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference number 20 and STANAG 5511, annex B, reference number 27.

13-2 Criteria

a. Reference number 20. For data transmission with modulation rates of 2400 Bd or less over VF channels, the total harmonic distortion produced by any single-frequency test signal within the frequency band between 300 Hz and 3000 Hz shall be at a level which is at least 30 dB below reference level (-30 dBm0) with a DO of -40 dBm0. The total harmonic distortion shall be measured with a standard test signal in accordance with paragraph 5.3.2.1.1. Paragraph 5.3.2.2.1 states the level of the standard test signal shall be 0 dBm at a 0TLP, or 0 dBm0, with a frequency of 1000 Hz, ±25 Hz. A test signal frequency of 1004 Hz is preferred for PCM transmission.

b. Reference number 27. The total harmonic distortion within the band between 600 and 2700 Hz produced by any single frequency test signal shall be at least 30 dB below reference level (-30 dBm0).

13-3 Test Procedures

a. Test Equipment Required

(1) Audio Generator

(2) Audio Breakout Box

(3) UUT

(4) Attenuator

(5) Measuring Receiver

(6) Spectrum Analyzer

b. Test Configuration. Configure the equipment as shown in figure 13-1.

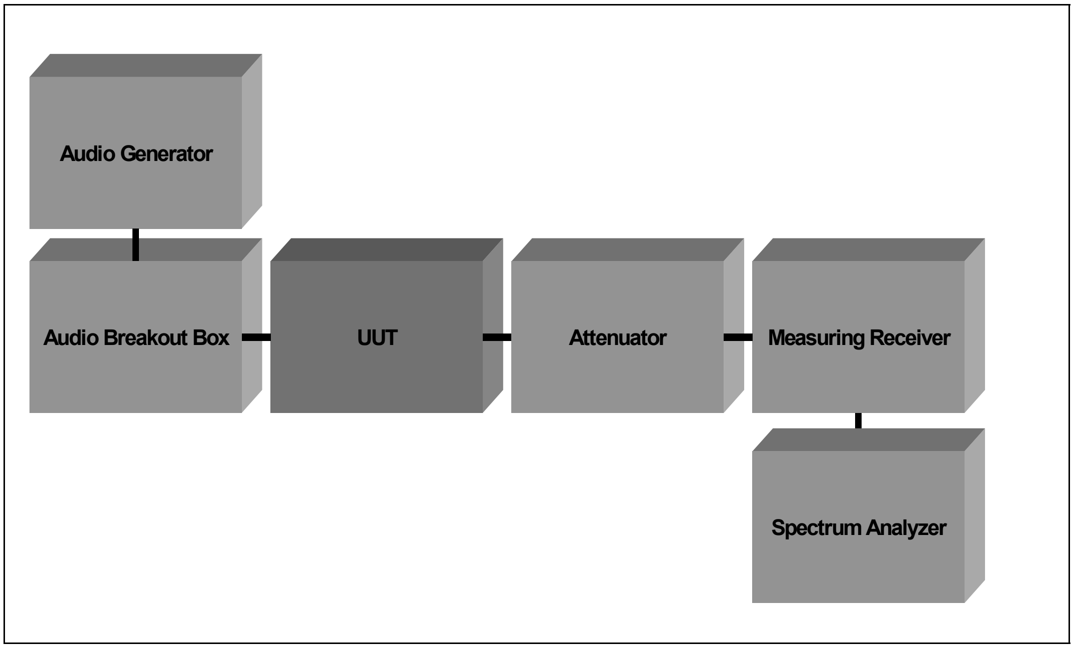


Figure 13-1. Total Harmonic Distortion Test Equipment Configuration

c. Test Conduct. For reference number 20, data rates are 2400 Bd or less. The test procedures are listed in table 13-1.

Table 13-1. Total Harmonic Distortion Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 20.			
1	Configure equipment.	As shown in figure 13-1.	
2	Configure audio generator.	Frequency: 1004 Hz Amplitude: 2.2 Vpp (0 dBm) Waveform: Sine	
3	Configure UUT.	Frequency: 350.000 MHz Plain text; Single channel	
4	Configure measuring receiver.	FM measurement	
5	Configure spectrum analyzer.	Center frequency: 1.5 kHz Span: 3 kHz Bandwidth average: On RF coupling: dc	
6	Configure audio breakout box.	Refer to manufacturer's specifications for correct pin out.	
7	Key UUT.	Observe the total harmonic distortion produced.	
8	On the spectrum analyzer.	Select markers. Adjust markers to 1004 Hz. Select delta pair. Record dB level at 4 Hz and 2004 Hz	Record reference level results on data collection form and test results matrix.

Table 13-1. Total Harmonic Distortion Test Procedures (continued)

Step	Action	Settings/Action	Result
9	Adjust audio generator frequency to 2100 Hz.	On the spectrum analyzer: Reset markers, select markers, adjust markers to 2100 Hz and record dB level. Select delta pair. Record dB level at 1100 Hz and 3100 Hz.	Record reference level results on data collection form and test results matrix.
10	Adjust audio generator frequency to 3000 Hz.	On the spectrum analyzer: Reset markers, select markers, adjust markers to 3000 Hz and record dB level. Select delta pair. Record dB level at 2000 Hz and 4000 Hz.	Record reference level results on data collection form and test results matrix.
11	Unkey UUT.		
The following procedures refer to reference number 27.			
12	Repeat steps 2 through 8 for the following audio tones.		
13	Change tone on audio generator to 600 Hz.	Record harmonic level.	Record measurement on data collection form and test results matrix.
14	Change tone on audio generator to 900 Hz.	Record harmonic level.	Record measurement on data collection form and test results matrix.
15	Change tone on audio generator to 1200 Hz.	Record harmonic level.	Record measurement on data collection form and test results matrix.
16	Change tone on audio generator to 1500 Hz.	Record harmonic level.	Record measurement on data collection form and test results matrix.
17	Change tone on audio generator to 2000 Hz.	Record harmonic level.	Record measurement on data collection form and test results matrix.
18	Change tone on audio generator to 2400 Hz.	Record harmonic level.	Record measurement on data collection form and test results matrix.

Table 13-1. Total Harmonic Distortion Test Procedures (continued)

Step	Action	Settings/Action	Result
19	Change tone on audio generator to 2700 Hz.	Record harmonic level.	Record measurement on data collection form and test results matrix.
Legend: dB - decibels dBm - dB referred to one milliwatt dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point dc - direct current FM - Frequency Modulation Hz - hertz kHz - kilohertz MHz - megahertz UUT - Unit Under Test Vpp - volts peak to peak			

13-4 Presentation of Results. The results will be shown in table 13-2 indicating the requirement and measured value or indications of capability.

Table 13-2. Total Harmonic Distortion Test Results

Reference Number	MIL-STD/ STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
20	MIL-STD 188-212 5.3.2.2.7	For data transmission with modulation rates of 2400 Bd or less over VF channels, the total harmonic distortion produced by any single-frequency test signal within the frequency band between 300 Hz and 3000 Hz shall be at a level which is at least 30 dB below reference level (-30 dBm0) with a DO of -40 dBm0. The total harmonic distortion shall be measured with a standard test signal in accordance with 5.3.2.1.1 (See note).	Frequencies between 300 Hz and 3000 Hz shall be at a level which is at least 30 dB below reference level.			
27	STANAG 5511 annex B 2.2.1.e	The total harmonic distortion within the band between 600 and 2700 Hz produced by any single frequency test signal shall be at least 30 dB below reference (-30 dBm0).	Frequencies between 600 and 2700 Hz shall be at least 30 dB below reference (-30 dBm0).			
Note: The level of the standard test signal shall be 0 decibels referenced to one milliwatt at a Zero Transmission Level Point, or 0 decibels referenced to one milliwatt, referenced to Zero Transmission Level Point, with a frequency of 1000 Hz, $\pm$25 Hz. A test signal frequency of 1004 Hz is preferred for Pulse Code Modulation transmission. **Legend:** Bd - baud dB - decibels dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point Hz - hertz MIL-STD - Military Standard STANAG - Standardization Agreement VF - Voice Frequency						

SUBTEST 14. INTERMODULATION DISTORTION AND LINEARITY

14-1 Objective. To determine the extent of compliance to the requirements of STANAG 5511, annex B, reference numbers 28, 34, and 38.

14-2 Criteria

a. Reference number 28. The individual intermodulation distortion products within the band between 600 Hz and 2700 Hz, produced by any two equal level tones introduced at -3 dBm0 in that band, shall be no greater than -38 dBm0.

b. Reference number 34. (Transmit) Intermodulation distortion shall be 30 dB below a two-tone test (935 and 1045 Hz) for a frequency deviation of ± 20 kHz.

c. Reference number 38. (Receive) Intermodulation distortion shall be 30 dB below a two-tone test (935 and 1045 Hz) for a frequency deviation of ± 20 kHz.

14-3 Test Procedures

a. Test Equipment Required

(1) UUT

(2) Attenuator

(3) Modulation Analyzer

(4) Spectrum Analyzer

(5) Signal Generator (w/Dual Audio Generator)

(6) Audio Breakout Box

(7) Dual Audio Generator

b. Test Configuration. Configure the equipment as shown in figures 14-1 and 14-2.

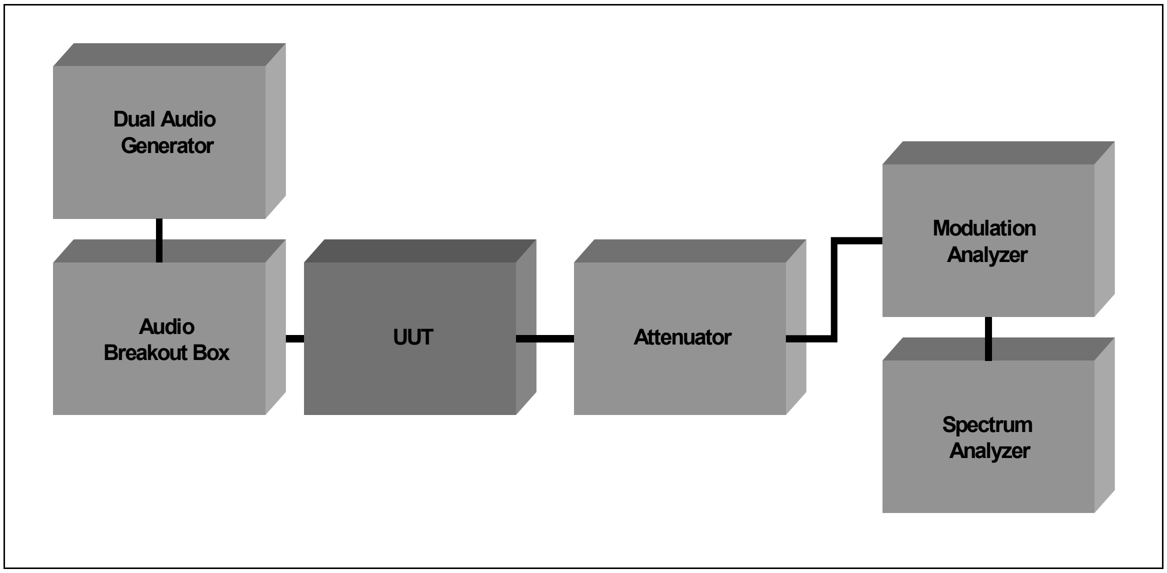


Figure 14-1. Intermodulation Distortion and Linearity (Transmit) Test Equipment Configuration

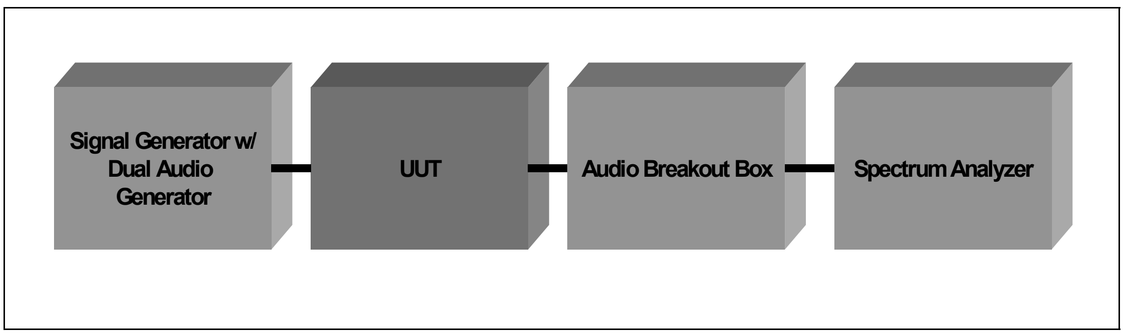


Figure 14-2. Linearity (Receive) Test Equipment Configuration

c. Test Conduct. The test procedures are listed in tables 14-1 and 14-2.

Table 14-1. Intermodulation Distortion and Linearity (Transmit) Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 28.			
1	Configure equipment.	As shown in figure 14-1.	
2	Configure UUT.	Frequency: 225.000 MHz Plain text; Single channel	
3	Configure dual audio generator.	Frequency A (Channel 1) Tone: 1000 Hz Amplitude: -3 dBm0 Frequency B (Channel 1) Tone: 1200 Hz Amplitude: -3 dBm0	

Table 14-1. Intermodulation Distortion and Linearity (Transmit) Test Procedures (continued)

Step	Action	Settings/Action	Result
4	Configure modulation analyzer.	FM deviation	
5	Configure spectrum analyzer.	Center Frequency: 2.5 kHz Frequency Span: 5 kHz Sweep: Single Noise Level: OFF	
6	Key breakout box and capture spectrum.	Set reference level on spectrum analyzer so the highest point is at 0 dB.	
7	On the spectrum analyzer set bandwidth average to 100. Select markers. Select the delta makers function.	Use delta makers to verify that all intermodulation distortion products are at least 38 dB below the level of the two tones.	Record measurement on data collection form and test results matrix.
8	Unkey breakout box.		
9	Repeat steps 6 through 8 for the following frequencies.		
10	Change frequency on UUT.	242.500 MHz	
11	Use delta makers to verify that all intermodulation distortion products are at least 38 dB below the level of the two tones.		Record measurement on data collection form and test results matrix.
12	Change frequency on UUT.	277.500 MHz	
13	Use delta makers to verify that all intermodulation distortion products are at least 38 dB below the level of the two tones.		Record measurement on data collection form and test results matrix.
14	Change frequency on UUT.	312.500 MHz	
15	Use delta makers to verify that all intermodulation distortion products are at least 38 dB below the level of the two tones.		Record measurement on data collection form and test results matrix.
16	Change frequency on UUT.	365.000 MHz	
17	Use delta makers to verify that all intermodulation distortion products are at least 38 dB below the level of the two tones.		Record measurement on data collection form and test results matrix.
18	Change frequency on UUT.	400.000 MHz	
19	Use delta makers to verify that all intermodulation distortion products are at least 38 dB below the level of the two tones.		Record measurement on data collection form and test results matrix.

Legend:
dB - decibels; Hz - hertz; MHz - megahertz
dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point; UUT - Unit Under Test
FM - Frequency Modulation; kHz - kilohertz

Table 14-2. Linearity Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 34.			
1	Connect the equipment.	As shown in figure 14-1.	
2	Configure the UUT.	Frequency: 225.000 MHz Plain text; Single channel Deviation: 10 kHz	
3	Configure the dual audio generator.	Tone 1: 935 Hz Amplitude: -3 dBm0 Tone 2: 1045 Hz Amplitude: -3 dBm0 Level: Adjust level for ± 20 kHz deviation. Waveform: Sine	
4	Configure the spectrum analyzer.	Center Frequency: 1 kHz Span: 5 kHz Set reference level as required.	
5	Configure the audio breakout box.	Refer to manufacturer's specifications for proper audio pin out.	
6	Set up modulation analyzer.	FM deviation.	
7	Measure peaks on spectrum analyzer.	Identify in-passband peaks other than frequencies tones 1 and 2 on the spectrum analyzer. Record the frequency and the difference (dB) between peak levels and two-tone levels for all peaks not less than 30 dB below the peak of either tone.	Record measurement on data collection form and test results matrix.
The following procedures refer to reference number 38.			
8	Connect the equipment.	As shown in figure 14-2.	
9	Configure the UUT.	Frequency: 225.000 MHz Plain text; Single channel Deviation: 20 kHz	
10	Configure the signal generator with dual audio generator.	Frequency: 225.000 MHz FM deviation: 20 kHz Tone 1: 935 Hz Tone 2: 1045 Hz Amplitude: - 90.00 dBm	
11	Configure spectrum analyzer.	Center frequency: 1 kHz Span: 2 kHz RF coupling: dc Bandwidth average: 100 counts	
12	Configure the audio breakout box.	Refer to manufacturer's specifications for proper audio pin out.	
13	Turn on RF and modulation of signal generator.	Observe spectrum analyzer.	

Table 14-2. Linearity Test Procedures (continued)

Step	Action	Settings/Action	Result
14	Measure peaks on spectrum analyzer.	Identify in-passband peaks other than frequencies tones 1 and 2 on the spectrum analyzer. Record the frequency and the difference (dB) between peak levels and two-tone levels for all peaks not less than 30 dB below the peak of either tone.	Record measurement on data collection form and test results matrix.
Legend: dB - decibels dBm - dB referred to one milliwatt dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point dc - direct current FM - Frequency Modulation Hz - hertz kHz - kilohertz MHz - megahertz RF - Radio Frequency UUT - Unit Under Test			

14-4 Presentation of Results. The results will be shown in table 14-3 indicating the requirement and measured value or indications of capability.

Table 14-3. Intermodulation Distortion and Linearity Test Results

Reference Number	STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
28	STANAG 5511 annex B 2.2.1.f	The individual intermodulation distortion products within the band between 600 Hz and 2700 Hz produced by any two equal level tones introduced at -3 dBm0 in that band shall be no greater than -38 dBm0.	Introduced at -3 dBm0 in that band shall be no greater than -38 dBm0.			
34	STANAG 5511 annex B 7.3.f	Intermodulation distortion shall be 30 dB below a two-tone test (935 and 1045 Hz) for a frequency deviation of ± 20 kHz.	30 dB below a two-tone test (935 and 1045 Hz) for a frequency deviation of ± 20 kHz.			

Table 14-3. Intermodulation Distortion and Linearity Test Results (continued)

Reference Number	STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
38	STANAG 5511 annex B 7.4.d	Intermodulation distortion shall be 30 dB below a two-tone test (935 and 1045 Hz) for a frequency deviation of ± 20 kHz.	30 dB below a two-tone test (935 and 1045 Hz) for a frequency deviation of ± 20 kHz.			

Note: The level of -3 dBm0 of the composite signal for Intermodulation Distortion measurements results in comparable peak loading of Voice Frequency channels for quasi-analog signals. The frequencies of the two equal level signals should be selected so that at least the third order harmonic products fall within the specified frequency band.

Legend:
± - plus or minus
dB - decibels
dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point
Hz - hertz
kHz - kilohertz
STANAG - Standardization Agreement

SUBTEST 15. IMPULSE NOISE

15-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference number 21.

15-2 Criteria. Reference number 21. For data transmission over VF channels, the impulse noise shall not exceed 15 counts above a level of 71 dBrn0 over any continuous 15-minute period. The impulse noise shall be measured at the quasi-analog input terminals of the demodulator of the receiving terminal subsystem with flat weighting over the frequency bandwidth occupied by the quasi-analog signals. The test instrument shall be capable of counting rates of up to 7.5 counts per second.

15-3 Test Procedures

a. Test Equipment Required

(1) Radio Frequency Keyer

(2) UUT (2 ea)

(3) Attenuator

(4) Audio Breakout Box

(5) TIMS

b. Test Configuration. Configure the equipment as shown in figure 15-1.

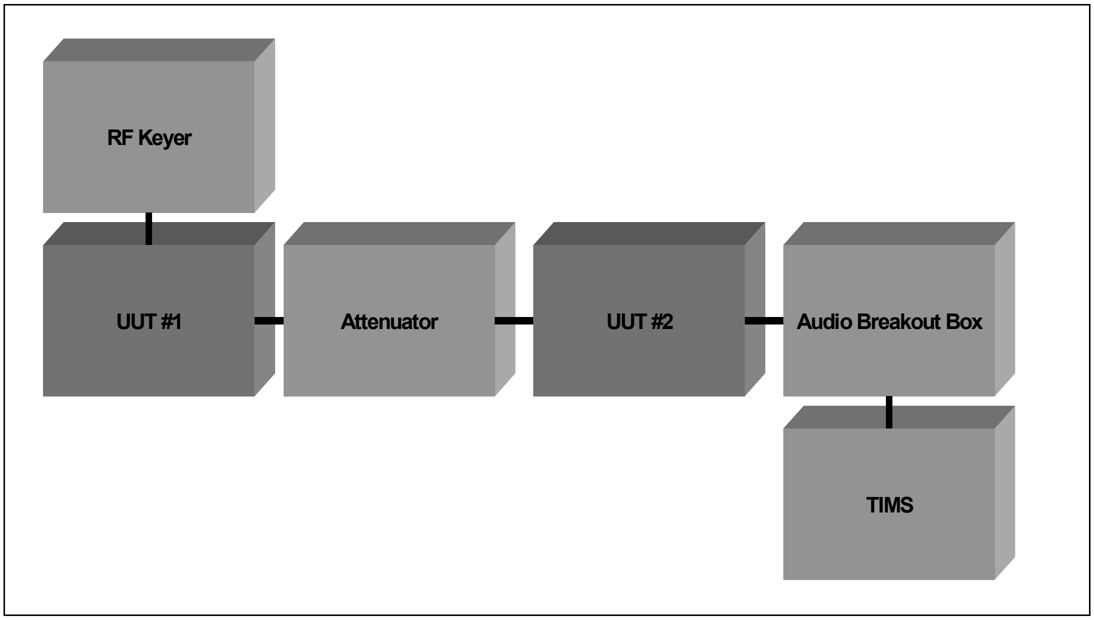


Figure 15-1. Impulse Noise Test Equipment Configuration

c. Test Conduct. Ensure the test instrument is capable of counting rates of up to 7.5 counts per second. This test will be measured at the modem input of the UUT. An audio breakout box may be necessary as shown in figure 15-1. The test procedures are listed in table 15-1.

Table 15-1. Impulse Noise Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 21.			
1	Configure equipment.	As shown in figure 15-1.	
2	Configure UUT 1 and 2.	Frequency: 312.500 MHz Plain text, Single channel	
3	Configure audio breakout box.	Check with manufacturer's specifications regarding the correct modem pins on the UUT.	
4	Configure TIMS.	Receive Measurement: Impulse noise Filter: C-message 71 dBrn Period: 15 minutes/Low	
5	Key UUT 1. Select start on TIMS.	Test will run for 15 minutes. Record number of counts on the display of TIMS.	Record counts on data collection form and test results matrix.
Legend: dBrn - decibels above reference noise MHz - megahertz	TIMS - Transmission Impairment Measurement Set UUT - Unit Under Test		

15-4 Presentation of Results. The results will be shown in table 15-2 indicating the requirement and measured value or indications of capability.

Table 15-2. Impulse Noise Test Results

Reference Number	MIL-STD Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
21	MIL-STD 188-212 5.3.2.3.1	For data transmission over VF channels, the impulse noise shall not exceed 15 counts above a level of 71 dBrn0 over any continuous 15-minute period. The impulse noise shall be measured at the quasi-analog input terminals of the demodulator of the receiving terminal subsystem with flat weighting over the frequency bandwidth occupied by the quasi-analog signals. The test instrument shall be capable of counting rates of up to 7.5 counts per second.	Not exceed 15 counts above a level of 71 dBrn0 over any continuous 15-minute period.			
			The impulse noise shall be measured at the quasi-analog input terminals of the demodulator of the receiving terminal subsystem with flat weighting over the frequency bandwidth occupied by the quasi-analog signals.			

Legend:
dBrn0 - decibels above reference noise, referenced to Zero Transmission Level Point
MIL-STD - Military Standard VF - Voice Frequency

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SUBTEST 16. PHASE JITTER/HITS

16-1 Objective. To determine the extent of compliance to the requirements of MIL-STD-188-212, reference numbers 22 and 23.

16-2 Criteria

a. Reference number 22. The total peak-to-peak phase jitter, imparted to a test tone traversing a VF channel at any frequency between 300 Hz and 3000 Hz, shall not exceed 15 degrees (DO: 10 degrees).

b. Reference number 23. For data transmission over VF channels, the number of phase hits of greater than ±20 degrees shall not exceed 15 hits over any continuous 15-minute period.

16-3 Test Procedures

a. Test Equipment Required

(1) Multifunction Synthesizer (2 ea)

(2) UUT

(3) Attenuator

(4) Measuring Receiver

(5) 2 Channel Oscilloscope

(6) Audio Breakout Box

b. Test Configuration. Configure the equipment as shown in figure 16-1.

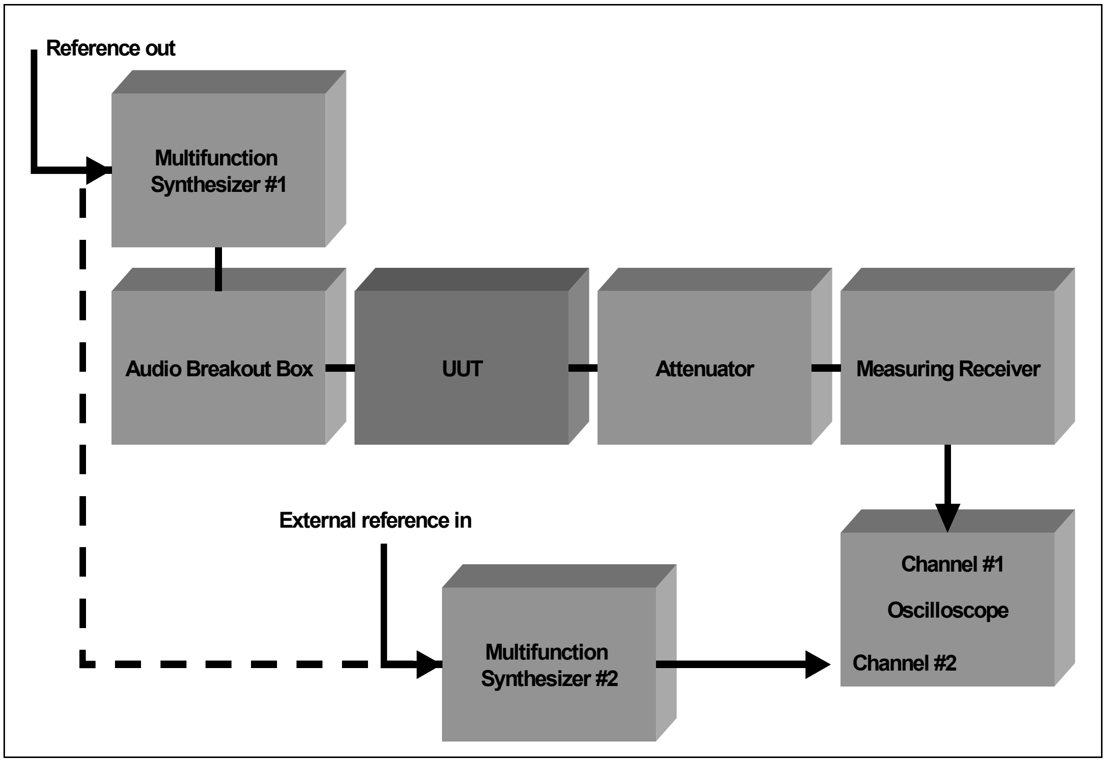

Figure 16-1. Phase Jitter/Hits Test Equipment Configuration

c. Test Conduct. A coax cable will be needed between multifunction synthesizer 1 and 2 for clock synchronization. The test procedures are listed in table 16-1.

Table 16-1. Phase Jitter/Hits Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference numbers 22 and 23.			
1	Configure equipment.	As shown in figure 16-1.	
2	Configure UUT.	Frequency: 312.500 MHz Plain text, Single channel	
3	Configure multifunction synthesizer 1.	Frequency: 1000 Hz Phase: 0 degrees Amplitude: 2.2 Vpp Desin: Out 1	
4	Configure multifunction synthesizer 2.	Frequency: 1000 Hz Phase: 0 degrees Amplitude: 1 volt Desin: Out 1	
5	Configure measuring receiver.	FM	

Table 16-1. Phase Jitter/Hits Test Procedures (continued)

Step	Action	Settings/Action	Result
6	Key breakout box. On oscilloscope, select channel 1 to the On position.	Adjust horizontal and vertical settings for proper trace. Adjust the amplitude on the multifunction synthesizer 1 for proper trace.	
7	On oscilloscope select channel 2 to the On position.	Adjust the amplitude and phase on the multifunction synthesizer 2 to overlap trace 1 with trace 2.	
8	On oscilloscope.	Select: measurement, time, phase, source 1 channel 1, and source 2 channel 2 (set up if for a (infiniium oscilloscope by Agilent).	
9	Phase test will run for 15 minutes. Set a stopwatch for a 15 minute time period.	Within the 15-minute test, every time the max degrees displays over 20 degrees, repeat step 8, continuing the stopwatch and recording the phase hit on the data collection form. Record the standard deviation degrees every time step 8 is repeated and at the end of the 15-minute test for peak-to-peak jitter.	Record measurements and restarts on data collection form and test results matrix.

Legend:
Desin - Destination | Hz - hertz | UUT - Unit Under Test
FM - Frequency Modulation | MHz - megahertz | Vpp - Volts peak to peak

16-4. Presentation of Results. The results will be shown in table 16-2 indicating the requirement and measured value or indications of capability.

Table 16-2. Phase Jitter/Hits Test Results

Reference Number	MIL-STD/ STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
22	MIL-STD 188-212 5.3.2.3.4	The total peak-to-peak phase jitter, imparted to a test tone traversing a VF channel at any frequency between 300 Hz and 3000 Hz, shall not exceed 15 degrees (DO: 10 degrees).	15 degrees			
23	MIL-STD 188-212 5.3.2.3.5	For data transmission over VF channels, the number of phase hits of greater than ±20 degrees shall not exceed 15 hits over any continuous 15-minute period.	±20 degrees shall not exceed 15 hits over any continuous 15-minute period.			

Legend:
± - plus or minus | Hz - hertz | VF - Voice Frequency
DO - Design Objective | MIL-STD - Military Standard

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SUBTEST 17. BANDPASS AND AUDIO FREQUENCY RESPONSE

17-1 Objective. To determine the extent of compliance to the requirements of STANAG 5511, annex B, reference numbers 25, 26, 30, and 36.

17-2 Criteria

a. Reference number 25. The nominal bandwidth at 1200 bps shall be 4 kHz.

b. Reference number 26. The nominal 3-dB points for the bandpass shall be within ± 2 dB for all frequencies between 1000 and 2400 Hz with respect to the Attenuator of a 1000-Hz signal.

c. Reference number 30. The audio frequency response between + 1.5-dB limits shall be 300 Hz to 3500 Hz (transmit).

d. Reference number 36. The audio frequency response between ± 1.5-dB limits shall be 300 Hz to 3500 Hz (receive).

17-3 Test Procedures

a. Test Equipment Required

(1) Audio Generator

(2) Audio Breakout Box

(3) UUT

(4) Signal Generator w/ Built-in Audio Generator

(5) Modulation Analyzer

(6) Attenuator

(7) Spectrum Analyzer

b. Test Configuration. Configure the equipment as shown in figures 17-1 and 17-2.

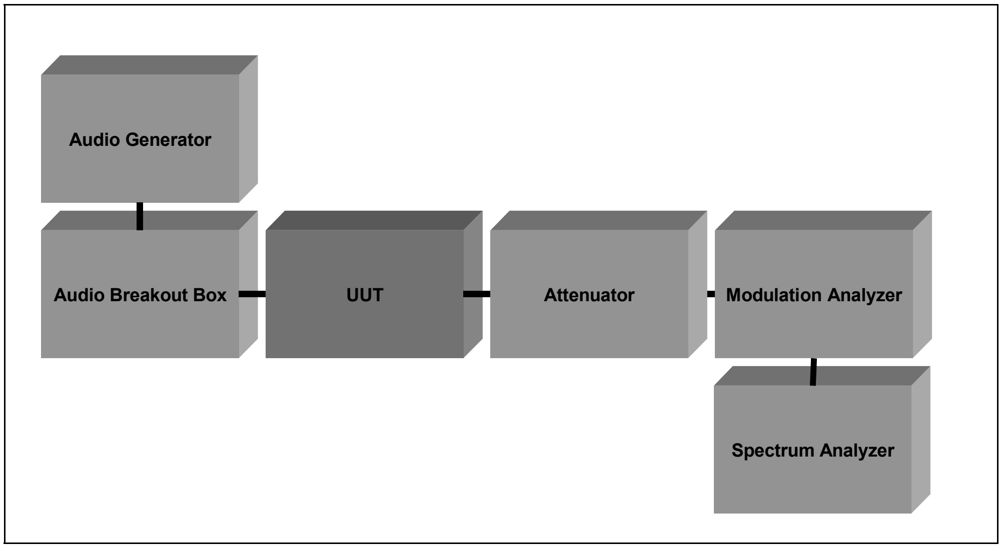

Figure 17-1. Bandpass and Audio Frequency Response Test Equipment Configuration (Transmit)

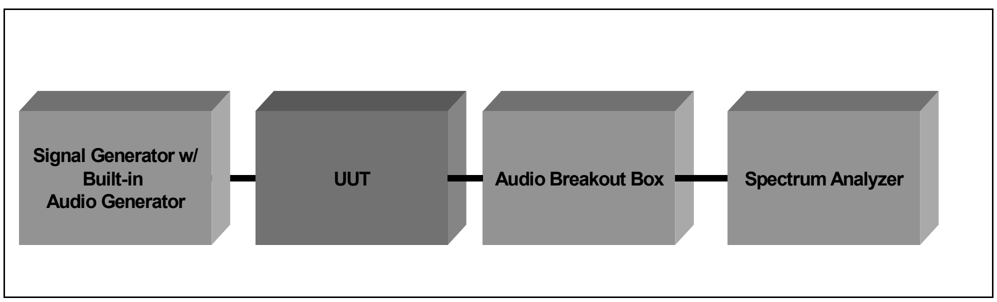

Figure 17-2. Audio Frequency Response Test Equipment Configuration (Receive)

c. Test Conduct. The test procedures for transmit are listed in tables 17-1 and 17-2.

Table 17-1. Bandpass Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 25.			
1	Configure equipment.	As shown in figure 17-1.	
2	Configure UUT.	Frequency: 225.000 MHz Plain text; Single channel	
3	Configure audio generator.	Frequency: 100 Hz	
4	Configure spectrum analyzer.	Center frequency: 3 kHz RF coupling: dc Span: 6 kHz Max hold: ON	
5	Configure audio breakout box.	Refer to manufacturer's specifications for correct pin out.	
6	Configure modulation analyzer.	FM deviation	

Table 17-1. Bandpass Test Procedures (continued)

Step	Action	Settings/Action	Result
7	Key audio breakout box.		
8	Select trace/view on the spectrum analyzer.	Select max hold. Allow spectrum analyzer to make a complete sweep.	
9	Adjust frequency of audio tone on audio generator.	Adjust tones from 200 Hz to 5000 Hz in 100-Hz increments with 2-second pauses between tone changes. Select view under trace/view menu on the spectrum analyzer.	
10	Select markers on the spectrum analyzer.	View spectrum analyzer and record bandwidth.	Record measurement on data collection form and test results matrix.
The following procedures refer to reference number 26.			
11	Reconfigure spectrum analyzer.	Center Frequency: 2 kHz Span: 4 kHz	
12	Adjust audio generator to 1000 Hz.	1000 Hz is reference level.	
13	Select max hold in the trace/view functions on the spectrum analyzer.	Key UUT.	
14	Adjust audio analyzer from 1000 Hz to 2400 Hz in 100-Hz steps. Allow spectrum analyzer to make a complete sweep.	Select view under the trace/view functions on the spectrum analyzer. Select markers. Adjust markers to 1000 Hz. Select the delta function under the marker function.	
15	Adjust marker from 1000 Hz to 2400 Hz in 100-Hz steps.	Record level at each 100-Hz step.	Record measurement on data collection form and test results matrix.
Legend: dc - direct current FM - Frequency Modulation	Hz - hertz kHz - kilohertz	MHz - megahertz UUT - Unit Under Test	

Table 17-2. Audio Frequency Response Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 30.			
1	Configure equipment.	As shown in figure 17-1.	
2	Configure UUT.	Frequency: 225.000 MHz Plain text; Single channel	
3	Configure audio generator.	Frequency: 300 Hz Amplitude: 2.2 Vpp	
4	Configure spectrum analyzer.	Center frequency: 2 kHz RF coupling: dc Span: 4 kHz Max hold: ON	

Table 17-2. Audio Frequency Response Test Procedures (continued)

Step	Action	Settings/Action	Result
5	Configure audio breakout box.	Refer to manufacturer's specifications for correct pin out.	
6	Configure modulation analyzer.	FM deviation.	
7	Key UUT with the audio breakout box.	Adjust amplitude on the spectrum analyzer for proper viewing.	
8	Select trace/view on the spectrum analyzer.	Select max hold and wait for 5 seconds for next step.	
9	Adjust audio tone on audio generator.	Select audio tones from 300 Hz to 3500 Hz in 100-Hz steps. Allow spectrum analyzer to make a complete sweep.	
10	Select display on the spectrum analyzer.	Adjust display line at highest audio tone peak. Annotate level at max audio tone peak (in dB).	
11	Adjust display line on the spectrum analyzer.	Adjust display line at lowest audio tone peak. Annotate level at max audio tone peak (in dB).	Record measurement on data collection form and test results matrix.
12	Calculate the difference between the highest and lowest audio tones displayed on the spectrum analyzer.	Are all tones within ±1.5 dB of the highest and lowest audio tones? Record measurements.	Record measurement on data collection form and test results matrix.
13	Repeat steps 2 through 11 for the following frequencies:		
14	Change center frequency on spectrum analyzer and frequency on UUT to 242.500 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
15	Change center frequency on spectrum analyzer and frequency on UUT to 260.000 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
16	Change center frequency on spectrum analyzer and frequency on UUT to 277.500 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
17	Change center frequency on spectrum analyzer and frequency on UUT to 295.000 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
18	Change center frequency on spectrum analyzer and frequency on UUT to 312.500 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.

Table 17-2. Audio Frequency Response Test Procedures (continued)

Step	Action	Settings/Action	Result
19	Change center frequency on spectrum analyzer and frequency on UUT to 330.000 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
20	Change center frequency on spectrum analyzer and frequency on UUT to 365.000 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
21	Change center frequency on spectrum analyzer and frequency on UUT to 382.500 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
22	Change center frequency on spectrum analyzer and frequency on UUT to 400.000 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
The following procedures refer to reference number 36.			
23	Configure equipment.	As shown in figure 17-2.	
24	Configure UUT.	Frequency: 225.000 MHz Plain text, Single channel Set UUT for max volume.	
25	Configure signal generator.	Frequency: 225.000 MHz Rate: 300 Hz tone	
26	Configure audio breakout box.	Connect correct audio pins on breakout box per manufacturer's specifications.	
27	Configure spectrum analyzer.	Center frequency: 2 kHz RF coupling: dc Span: 4 kHz Max hold: ON	
28	On the signal generator turn the RF and modulation functions to ON.	Adjust amplitude on the spectrum analyzer for proper viewing.	
29	Select trace/view on the spectrum analyzer.	Select max hold and wait for a complete sweep.	Record measurement on data collection form and test results matrix.
30	Adjust audio tone on signal generator.	Adjust tones from 300 Hz to 3500 Hz in 100-Hz increments. Allow spectrum analyzer for a complete sweep on each 100-Hz increment.	Record measurement on data collection form and test results matrix.

Table 17-2. Audio Frequency Response Test Procedures (continued)

Step	Action	Settings/Action	Result
31	Select display on the spectrum analyzer.	Adjust display line at highest audio tone peak. Annotate level in dB at max audio tone peak.	Record measurement on data collection form and test results matrix.
32	Adjust display line on the spectrum analyzer.	Adjust display line at highest audio tone peak. Annotate level in dB at max audio tone peak.	Record measurement on data collection form and test results matrix.
33	Calculate the difference between the highest and lowest audio tones displayed on the spectrum analyzer.	Record measurements.	Record measurement on data collection form and test results matrix.
34	Repeat steps 23 through 33 for the following frequencies:	Record measurements.	Record measurement on data collection form and test results matrix.
35	Change center frequency on spectrum analyzer and frequency on UUT to 242.500 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
36	Change center frequency on spectrum analyzer and frequency on UUT to 260.000 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
37	Change center frequency on spectrum analyzer and frequency on UUT to 277.500 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
38	Change center frequency on spectrum analyzer and frequency on UUT to 295.000 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
39	Change center frequency on spectrum analyzer and frequency on UUT to 312.500 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
40	Change center frequency on spectrum analyzer and frequency on UUT to 330.000 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.

Table 17-2. Audio Frequency Response Test Procedures (continued)

Step	Action	Settings/Action	Result
41	Change center frequency on spectrum analyzer and frequency on UUT to 365.000 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
42	Change center frequency on spectrum analyzer and frequency on UUT to 382.500 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
43	Change center frequency on spectrum analyzer and frequency on UUT to 400.000 MHz.	Record measurements.	Record measurement on data collection form and test results matrix.
Legend: dB - decibels dc - direct current FM - Frequency Modulation Hz - hertz	kHz - kilohertz MHz - megahertz mV - millivolts RF - Radio Frequency	UUT - Unit Under Test Vpp - volts-peak to-peak	

17-4 Presentation of Results. The results will be shown in table 17-3 indicating the requirement and measured value or indications of capability.

Table 17-3. Bandpass and Audio Frequency Response Test Results

Reference Number	STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
25	STANAG 5511 annex B 2.2.1.b	The nominal bandwidth at 1200 bits per second shall be 4 kHz.	4 kHz			
26	STANAG 5511 annex B 2.2.1.c	The nominal 3-dB points for the band pass shall be within ± 2 dB for all frequencies between 1000 and 2400 Hz with respect to the Attenuator of a 1000-Hz signal.	+2 dB for all frequencies between 1000 and 2400 Hz.			
30	STANAG 5511 annex B 7.3.b	The audio frequency response between + 1.5-dB limits shall be 300 Hz to 3500 Hz (transmit).	+ 1.5-dB limits shall be 300 Hz to 3500 Hz (transmit).			

Table 17-3. Bandpass and Audio Frequency Response Test Results (continued)

Reference Number	STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
36	STANAG 5511 annex B 7.4.b	The audio frequency response between ± 1.5-dB limits shall be 300 Hz to 3500 Hz (receive).	± 1.5-dB limits shall be 300 Hz to 3500 Hz (receive).			

Legend:
± - plus or minus
dB - decibels
Hz - hertz
kHz - kilohertz
STANAG - Standardization Agreement

SUBTEST 18. DEVIATION

18-1 Objective. To determine the extent of compliance to the requirements of STANAG 5511, annex B, reference numbers 31 and 37.

18-2 Criteria

a. Reference number 31. A signal of + 10 dBm at the audio output shall produce up to ± 20-kHz deviation of the output frequency.

b. Reference number 37. An input of ± 20-kHz deviation and 100 microvolts (hard) to the receiver shall produce a signal output of 10 dBm.

18-3 Test Procedures

a. Test Equipment Required

(1) UUT

(2) UUT Keyer

(3) Signal Generator

(4) Modulation Analyzer

(5) Audio Breakout Box

(6) Audio Analyzer

(7) Audio Generator

(8) Attenuator

b. Test Configuration. Configure the equipment as shown in figures 18-1 and 18-2.

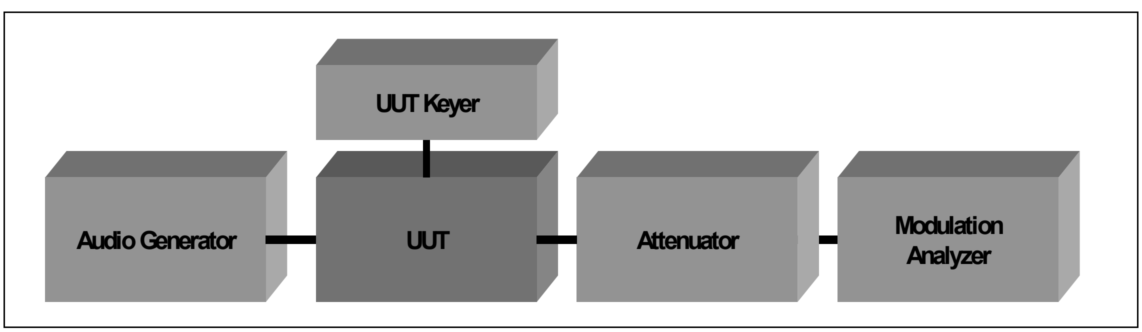

Figure 18-1. Deviation (Transmit)

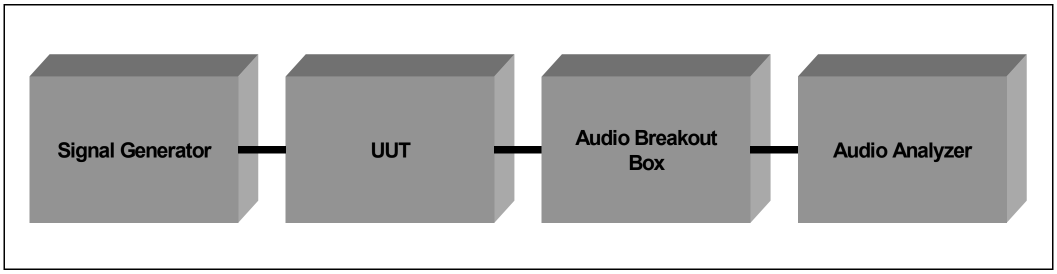

Figure 18-2. Deviation (Receive)

c. Test Conduct. The test procedures are listed in table 18-1.

Table 18-1. Deviation Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 31.			
1	Configure equipment.	As shown in figure 18-1.	
2	Configure UUT.	Frequency: 225.000 MHz Plain text, Single channel Internal deviation +10 Hz (See note)	
3	Configure audio analyzer.	+ 10 dBm, 1000 Hz	
4	Key UUT with UUT keyer.	Record deviation from modulation analyzer display.	Record deviation results on data collection form and test results matrix.
5	Unkey UUT. Change frequency on UUT to 242.500 MHz. Key UUT.	Record deviation from modulation analyzer display.	Record deviation results on data collection form and test results matrix.
6	Unkey UUT. Change frequency on UUT to 260.000 MHz. Key UUT.	Record deviation from modulation analyzer display.	Record deviation results on data collection form and test results matrix.
7	Unkey UUT. Change frequency on UUT to 277.500 MHz. Key UUT.	Record deviation from modulation analyzer display.	Record deviation results on data collection form and test results matrix.
8	Unkey UUT. Change frequency on UUT to 295.000. Key UUT.	Record deviation from modulation analyzer display.	Record deviation results on data collection form and test results matrix.
9	Unkey UUT. Change frequency on UUT to 312.500 MHz. Key UUT.	Record deviation from modulation analyzer display.	Record deviation results on data collection form and test results matrix.
10	Unkey UUT. Change frequency on UUT to 330.000 MHz. Key UUT.	Record deviation from modulation analyzer display.	Record deviation results on data collection form and test results matrix.

Table 18-1. Deviation Test Procedures (continued)

Step	Action	Settings/Action	Result
11	Unkey UUT. Change frequency on UUT to 365.000 MHz. Key UUT.	Record deviation from modulation analyzer display.	Record deviation results on data collection form and test results matrix.
12	Unkey UUT. Change frequency on UUT to 382.500 MHz. Key UUT.	Record deviation from modulation analyzer display.	Record deviation results on data collection form and test results matrix.
13	Unkey UUT. Change frequency on UUT to 400.000 MHz. Key UUT.	Record deviation from modulation analyzer display.	Record deviation results on data collection form and test results matrix.
The following procedures refer to reference number 37.			
14	Configure equipment.	As shown in figure 18-2.	
15	Configure UUT.	Frequency: 225.000 MHz Plain text, Single channel Internal deviation +10 kHz (See note)	
16	Configure modulation analyzer.	FM deviation	
17	Configure signal generator.	Frequency: 225.000 MHz RF: OFF Mod: OFF Deviation: ± 20 kHz Amplitude: -67 dBm (100 µV)	
18	On the signal generator turn RF and Mod to ON.	Record audio analyzer display.	Record results on data collection form and test results matrix.
19	Turn RF and Mod on the signal generator to OFF. Change frequencies on the signal generator and UUT to 242.500 MHz. On the signal generator turn RF and Mod to on.	Record audio analyzer display.	Record results on data collection form and test results matrix.
20	Turn RF and Mod on the signal generator to OFF. Change frequencies on the signal generator and UUT to 260.000 MHz. On the signal generator turn RF and Mod to ON.	Record audio analyzer display.	Record results on data collection form and test results matrix.
21	Turn RF and Mod on the signal generator to OFF. Change frequencies on the signal generator and UUT to 277.500 MHz. On the signal generator turn RF and Mod to ON.	Record audio analyzer display.	Record results on data collection form and test results matrix.
22	Turn RF and Mod on the signal generator to OFF. Change frequencies on the signal generator and UUT to 295.000 MHz. On the signal generator turn RF and Mod to ON.	Record audio analyzer display.	Record results on data collection form and test results matrix.

Table 18-1. Deviation Test Procedures (continued)

Step	Action	Settings/Action	Result
23	Turn RF and Mod on the signal generator to OFF. Change frequencies on the signal generator and UUT to 312.500 MHz. On the signal generator turn RF and Mod to ON.	Record audio analyzer display.	Record results on data collection form and test results matrix.
24	Turn RF and Mod on the signal generator to OFF. Change frequencies on the signal generator and UUT to 330.000 MHz. On the signal generator turn RF and Mod to ON.	Record audio analyzer display.	Record results on data collection form and test results matrix.
25	Turn RF and Mod on the signal generator to OFF. Change frequencies on the signal generator and UUT to 365.000 MHz. On the signal generator turn RF and Mod to ON.	Record audio analyzer display.	Record results on data collection form and test results matrix.
26	Turn RF and Mod on the signal generator to OFF. Change frequencies on the signal generator and UUT to 382.500 MHz. On the signal generator turn RF and Mod to ON.	Record audio analyzer display.	Record results on data collection form and test results matrix.
27	Turn RF and Mod on the signal generator to OFF. Change frequencies on the signal generator and UUT to 400.000 MHz. On the signal generator turn RF and Mod to ON.	Record audio analyzer display.	Record results on data collection form and test results matrix.

Note: The tested Unit Under Test may not have the internal capability to be adjusted to +10 dBm depending on the manufacturer's design.

Legend:

dBm - dB referred to one milliwatt	kHz - kilohertz	RF - Radio Frequency
FM - Frequency Modulation	MHz - megahertz	UUT - Unit Under Test
Hz - hertz	mod - modification	

18-4 Presentation of Results. The results will be shown in table 18-2 indicating the requirement and measured value or indications of capability.

Table 18-2. Deviation Test Results

Reference Number	STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
31	STANAG 5511 annex B 7.3.c	A signal of + 10 dBm at the audio output shall produce up to ± 20-kHz deviation of the output frequency.	± 20 kHz			

Table 18-2. Deviation Test Results (continued)

Reference Number	STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
37	STANAG 5511 annex B 7.4.c	An input of ± 20-kHz deviation and 100 microvolts (hard) to the receiver shall produce a signal output of +10 dBm.	+10 dBm			

Legend:
dB - decibels
dBm - dB referred to one milliwatt
kHz - kilohertz
STANAG - Standardization Agreement

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SUBTEST 19. OUTPUT LEVEL

19-1 Objective. To determine the extent of compliance to the requirements of STANAG 5511, annex B, reference numbers 33 and 35.

19-2 Criteria

a. Reference number 33. The transmitted output level shall be within 1 dB of its steady-state output within 7 ms of the receipt of a keying signal.

b. Reference number 35. The receiver output shall be within 1 dB of its steady-state value within 12 milliseconds (ms) after application of the Radio Frequency (RF) signal. The output level shall be constant, within ± 3 dB for inputs from 5 microvolts to 50 millivolts (hard).

19-3 Test Procedures

a. Test Equipment Required

(1) UUT

(2) Oscilloscope

(3) Attenuator

(4) Audio Analyzer

(5) Audio Breakout Box

(6) UUT Keyer

(7) Signal Generator

b. Test Configuration. Configure the equipment as shown in figure 19-1 (transmit) and figures 19-2 and 19-3 (receive).

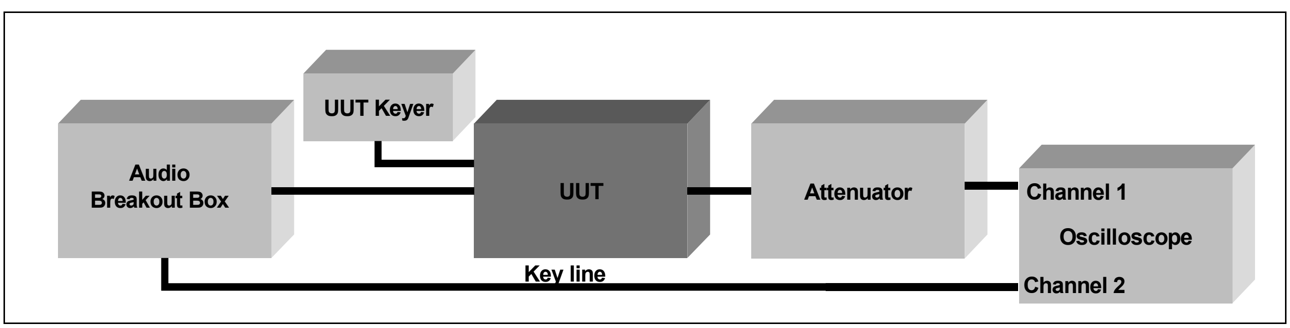

Figure 19-1. Output Level (Transmit) Test Equipment Configuration

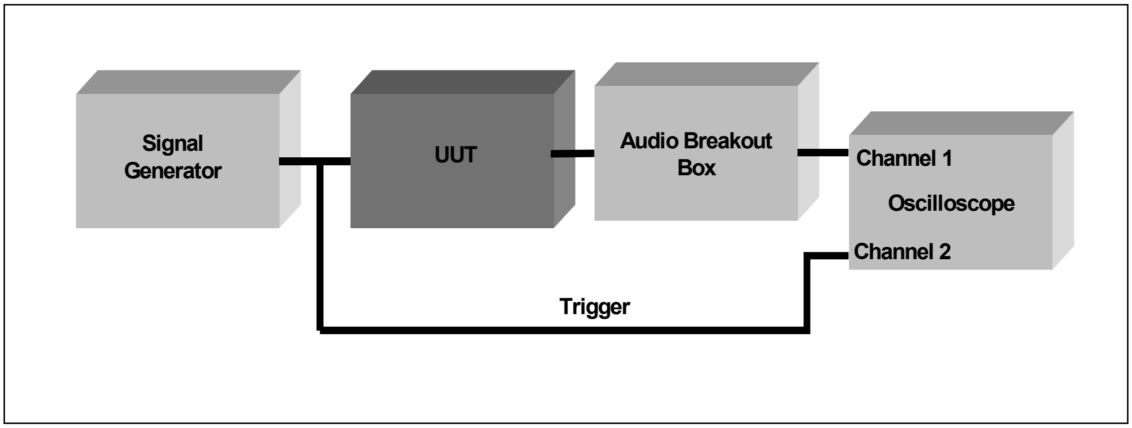

Figure 19-2. Output Level (Receive) Test Equipment Configuration (Part 1)

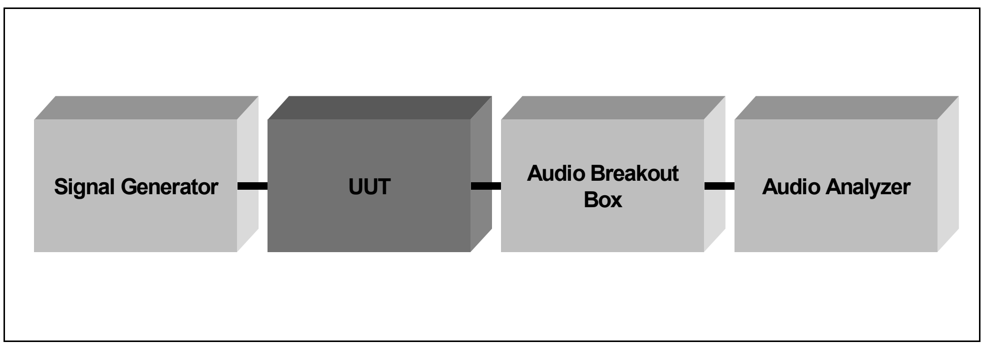

Figure 19-3. Output Level (Receive) Test Equipment Configuration (Part 2)

c. Test Conduct. The test procedures are listed in table 19-1.

Table 19-1. Output Level Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 33.			
1	Configure equipment.	As shown in figure 19-1.	
2	Configure UUT.	Frequency: 225.000 MHz Plain text; Single channel	
3	Configure audio breakout box.	Refer to manufacturer's specification for correct pin out.	
4	Configure oscilloscope.	CH 1 (RF): 500 mV per division CH 2 (Key line): 2 V per division Horizontal: 2 ms per division	
5	Key the UUT.	Observe the results on the oscilloscope.	
6	Set the marker on the oscilloscope.	Marker A: Key ON Marker B: RF signal within 1 dB of steady-state.	

Table 19-1. Output Level Test Procedures (continued)

Step	Action	Settings/Action	Result
7	Record results, unkey UUT, and clear oscilloscope.	Ensure marker A and B are less than 7 ms apart. Record results.	Record measurement on data collection form and test results matrix.
8	Repeat steps 2 through 7 for the following frequencies.		
9	Change frequency on UUT to 242.500 MHz.	Ensure marker A and B are less than 7 ms apart. Record measurement.	Record measurement on data collection form and test results matrix.
10	Change frequency on UUT to 260.000 MHz.	Ensure marker A and B are less than 7 ms apart. Record measurement.	Record measurement on data collection form and test results matrix.
11	Change frequency on UUT to 277.500 MHz.	Ensure marker A and B are less than 7 ms apart. Record measurement.	Record measurement on data collection form and test results matrix.
12	Change frequency on UUT to 295.000 MHz.	Ensure marker A and B are less than 7 ms apart. Record measurement.	Record measurement on data collection form and test results matrix.
13	Change frequency on UUT to 312.500 MHz.	Ensure marker A and B are less than 7 ms apart. Record measurement.	Record measurement on data collection form and test results matrix.
14	Change frequency on UUT to 330.000 MHz.	Ensure marker A and B are less than 7 ms apart. Record measurement.	Record measurement on data collection form and test results matrix.
15	Change frequency on UUT to 365.000 MHz.	Ensure marker A and B are less than 7 ms apart. Record measurement.	Record measurement on data collection form and test results matrix.
16	Change frequency on UUT to 382.500 MHz.	Ensure marker A and B are less than 7 ms apart. Record measurement.	Record measurement on data collection form and test results matrix.
17	Change frequency on UUT to 400.000 MHz.	Ensure marker A and B are less than 7 ms apart. Record measurement.	Record measurement on data collection form and test results matrix.

Table 19-1. Output Level Test Procedures (continued)

Step	Action	Settings/Action	Result
The following procedures refer to reference number 35.			
18	Configure equipment.	As shown in figure 19-2.	
19	Configure UUT.	Frequency: 225.0000 MHz Plain text; Single channel	
20	Configure oscilloscope.	Horizontal scale: 50 mV per division. Vertical scale: 2.190 V per division. Trigger: Single sweep CH 1 (RF): 50 mV per division CH 2 (Key line): 1 V per division	
21	Configure audio breakout box.	Refer to manufacturer's specification for correct pin out.	
22	Select run on oscilloscope.		
23	Configure signal generator.	Frequency: 225.000 MHz Amplitude: -90 dBm Rate: 1000 Hz Waveform: Sine	
24	Turn the modulation and the RF functions to the on position on the signal generator.	Stop the acquisition on the oscilloscope.	
25	Set the markers A and B on the oscilloscope.	Marker A: At the beginning of the RF signal. Marker B: At the point where the audio is in 1 dB of its steady-state output. Measure the differences between markers A and B to ensure marker are within 12 ms.	Record measurement on data collection form and test results matrix.
26	Reset oscilloscope. Repeat steps 20 through 25 for the following frequencies.	Measure the differences between markers A and B to ensure marker is within 12 ms. Record measurement.	Record measurement on data collection form and test results matrix.
27	Change frequency on UUT to 242.500 MHz.	Measure the differences between markers A and B to ensure marker is within 12 ms. Record measurement.	Record measurement on data collection form and test results matrix.
28	Change frequency on UUT to 260.000 MHz.	Measure the differences between markers A and B to ensure marker is within 12 ms. Record measurement.	Record measurement on data collection form and test results matrix.
29	Change frequency on UUT to 277.500 MHz.	Measure the differences between markers A and B to ensure marker is within 12 ms. Record measurement.	Record measurement on data collection form and test results matrix.

Table 19-1. Output Level Test Procedures (continued)

Step	Action	Settings/Action	Result
30	Change frequency on UUT to 295.000 MHz.	Measure the differences between markers A and B to ensure marker is within 12 ms. Record measurement.	Record measurement on data collection form and test results matrix.
31	Change frequency on UUT to 312.500 MHz.	Measure the differences between markers A and B to ensure marker is within 12 ms. Record measurement.	Record measurement on data collection form and test results matrix.
32	Change frequency on UUT to 330.000 MHz.	Measure the differences between markers A and B to ensure marker is within 12 ms. Record measurement.	Record measurement on data collection form and test results matrix.
33	Change frequency on UUT to 365.000 MHz.	Measure the differences between markers A and B to ensure marker is within 12 ms. Record measurement.	Record measurement on data collection form and test results matrix.
34	Change frequency on UUT to 382.500 MHz.	Measure the differences between markers A and B to ensure marker is within 12 ms. Record measurement.	Record measurement on data collection form and test results matrix.
35	Change frequency on UUT to 400.000 MHz.	Measure the differences between markers A and B to ensure marker is within 12 ms. Record measurement.	Record measurement on data collection form and test results matrix.
36	Reconfigure equipment.	As shown on figure 19-3.	
37	Configure the signal generator.	Frequency: 225.000 MHz Rate: 1 kHz Amplitude: 5 μV	
38	Change frequency on UUT.	Frequency: 225.000 MHz	
39	Configure audio breakout box.	Refer to manufacturer's specification for correct pin out.	
40	Configure the audio analyzer.	Select ac level.	
41	Turn the modulation and the RF functions to the ON position on the signal generator.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
42	Change the amplitude on signal generator for the following steps.		
43	Change amplitude to 10 μV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
44	Change amplitude to 20 μV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.

Table 19-1. Output Level Test Procedures (continued)

Step	Action	Settings/Action	Result
45	Change amplitude to 30 µV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
46	Change amplitude to 40 µV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
47	Change amplitude to 50 µV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
48	Change amplitude to 100 µV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
49	Change amplitude to 200 µV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
50	Change amplitude to 300 µV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
51	Change amplitude to 400 µV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
52	Change amplitude to 500 µV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
53	Change amplitude to 1 mV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
54	Change amplitude to 10 mV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
55	Change amplitude to 20 mV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
56	Change amplitude to 30 mV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
57	Change amplitude to 40 mV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.

Table 19-1. Output Level Test Procedures (continued)

Step	Action	Settings/Action	Result
58	Change amplitude to 50 mV.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
59	Calculate results.	Ensure all amplitude readings for 225.000 MHz are within ± 3 dB.	Record level on data collection form and test results matrix.
60	Turn the modulation and the RF functions to the OFF position on the signal generator.		
61	Repeat steps 37 through 59 for the following frequencies.		
62	Change frequency on UUT and signal generator to 242.500 MHz.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
63	Change frequency on UUT and signal generator to 260.000 MHz.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
64	Change frequency on UUT and signal generator to 277.500 MHz.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
65	Change frequency on UUT and signal generator to 295.000 MHz.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
66	Change frequency on UUT and signal generator to 312.500 MHz.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
67	Change frequency on UUT and signal generator to 330.000 MHz.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
68	Change frequency on UUT and signal generator to 365.000 MHz.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.
69	Change frequency on UUT and signal generator to 382.500 MHz.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.

Table 19-1. Output Level Test Procedures (continued)

Step	Action	Settings/Action	Result
70	Change frequency on UUT and signal generator to 400.000 MHz.	Observe the audio analyzer for a stable reading. Record the level displayed on the audio analyzer in dBm.	Record level on data collection form and test results matrix.

Legend:
± - plus or minus
μV - microvolts
ac - alternating current
dB - decibels
dBm; dB referred to one milliwatt
CH - Channel
kHz - kilohertz
MHz - megahertz
ms - milliseconds
mV - millivolts
RF - Radio Frequency
UUT - Unit Under Test
V - volts

19-4 Presentation of Results. The results will be shown in table 19-2 indicating the requirement and measured value or indications of capability.

Table 19-2. Output Level Test Results

Reference Number	STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
33	STANAG 5511 annex B 7.3.e	The transmitted output level shall be within 1 dB of its steady-state output within 7 ms of the receipt of a keying signal.	Within 1 dB of its steady-state output within 7 ms of the receipt of a keying signal.			
35	STANAG 5511 annex B 7.4.a	The receiver output shall be within 1 dB of its steady-state value within 12 ms after application of the RF signal. The output level shall be constant, within ± 3 dB for inputs from 5 microvolts to 50 millivolts (hard).	Within 1 dB of its steady-state value within 12 ms after application of the RF signal.			
			Within ± 3 dB for inputs from 5 microvolts to 50 millivolts (hard).			

Legend:
± - plus or minus
dB - decibels
ms - milliseconds
RF Radio Frequency
STANAG - Standardization Agreement

SUBTEST 20. PROTECTION

20-1 Objective. To determine the extent of compliance to the requirements of STANAG 5511, annex B, reference number 39.

20-2 Criteria. Reference number 39. The receiver shall be protected when the transmitter is a full power and the electrical isolation between the transmitter and receiver antenna terminals is as low as 26 dB. The protection circuit shall activate within 150 ms time interval used by the transmitter to go from the carrier "ON" to the carrier "OFF" condition. Provisions shall be made to override the protection circuitry to the extent required to monitor the transmitter at full power. The override feature shall provide the required receiver output when the electrical isolation between the transmitter antenna terminal and receiver antenna terminals is in the range 26 dB to 36 dB.

20-3 Test Procedures

a. Test Equipment Required

(1) Audio Generator

(2) UUT

(3) Step Attenuator

(4) 10 dB Attenuator

(5) Audio Analyzer

(6) Power Meter

b. Test Configuration. Configure the equipment as shown in figure 20-1.

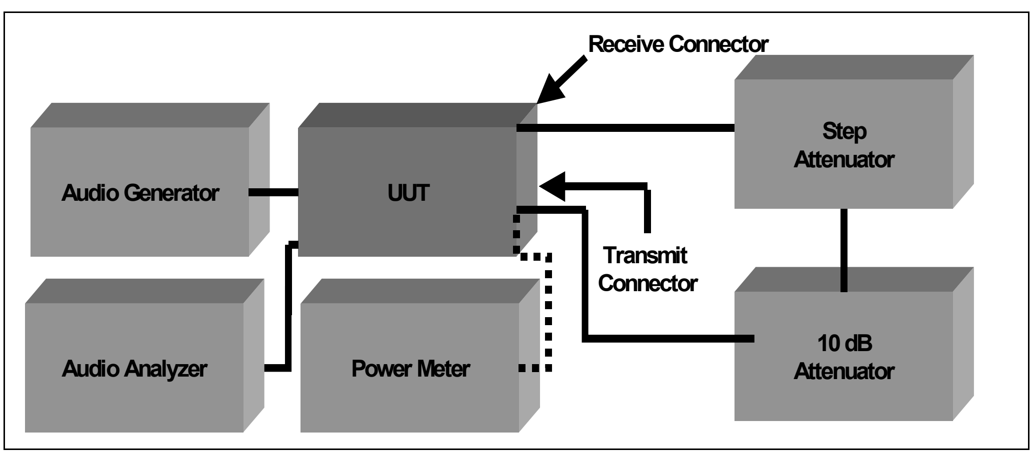

Figure 20-1. Protection Test Equipment Configuration

c. Test Conduct. This subtest should be the last test conducted. This subtest may damage the UUT if the UUT does not meet criteria given in STANAG 5511, annex B, paragraph 7.4.e. Confirm the limits of the UUT with the manufacturer before testing. The procedures for this subtest are listed in table 20-1.

Table 20-1. Protection Test Procedures

Step	Action	Settings/Action	Result
The following procedures refer to reference number 39.			
1	Configure equipment.	As shown in figure 20-1.	
2	Configure UUT.	Set to transmit full power on 225.000 MHz.	
3	Configure audio generator.	Frequency: 1000 Hz Amplitude: 0 dBm	
4	Configure audio analyzer.	Measurement: SINAD Low pass filter: 30 kHz	
5	Configure power meter.	Display: Watts Check with UUT's specifications regarding the UUT's max power output and power meter max power input rating meets UUT's max power specifications.	
6	Connect UUT directly to power meter. Key UUT.	Warning: This subtest may damage the UUT if the UUT does not meet criteria given in STANAG 5511, annex B, paragraph 7.4.e. Confirm the limits of the UUT with the manufacturer before proceeding. Verify power meter display with manufacturer's specification to ensure UUT is at max power. Record measurement.	Record measurement on data collection form and test results matrix.
7	Unkey UUT.	Disconnect power meter and reconnect equipment as shown in figure 20-1.	
8	Adjust attenuator for 26 dB.		
9	Key UUT for a period of 5 minutes.	Verify that the UUT is able to survive under these conditions. Record level at audio analyzer.	Record measurement on data collection form and test results matrix.
10	Increase dB level of step attenuator in 3-dB steps.	Record levels on audio analyzer for each 2-dB step until 36 dB is reached.	Record measurement on data collection form and test results matrix.

Legend:
dB - decibels
dBm - dB referred to one milliwatt
Hz - hertz
kHz - kilohertz
MHz - megahertz
STANAG - Standardization Agreement
UUT - Unit Under Test

20-4 Presentation of Results. The results will be shown in table 20-2 indicating the requirement and measured value or indications of capability.

Table 20-2. Protection Test Results

Reference Number	STANAG Paragraph	Requirement	Result		Finding	
			Required Value	Measured Value	Met	Not Met
39	STANAG 5511 annex B 7.4.e	The receiver shall be protected when the transmitter is a full power and the electrical isolation between the transmitter and receiver antenna terminals is as low as 26 dB. The protection circuit shall activate within 150 ms time interval used by the transmitter to go from the carrier "ON" to the carrier "OFF" condition. Provisions shall be made to override the protection circuitry to the extent required to monitor the transmitter at full power. The override feature shall provide the required receiver output when the electrical isolation between the transmitter antenna terminal and receiver antenna terminals is in the range 26 dB to 36 dB.	The receiver shall be protected when the transmitter is a full power and the electrical isolation between the transmitter and receiver antenna terminals is as low as 26 dB.			
			The override feature shall provide the transmitter antenna terminal and receiver antenna terminals is in the range 26 dB to 36 dB.			

Legend:
dB - decibels ms - millisecond STANAG - Standardization Agreement

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APPENDIX A

ACRONYMS

µA	microamperes
ac	alternating current
Bd	baud
bps	bit per second
BER	Bit Error Rate
dB	decibels
dBm	dB referred to one milliwatt
dBm0	noise power in dBm referred to or measured at Zero Transmission Level Point
dBrn	decibels above reference noise
dBrn0	decibels above reference noise, referenced to Zero Transmission Level Point
dc	direct current
DCAC	Defense Communications Agency Circular
DCS	Defense Communications System
DO	Design Objective
FDM	Frequency Division Multiplex
FM	Frequency Modulation
FSK	Frequency Shift Keying
Hz	hertz
kHz	kilohertz
km	kilometer
mA	milliampere
MHz	megahertz
MIL-STD	Military Standard
ms	milliseconds
PCM	Pulse Code Modulation
pW0	picowatts referenced to Zero Transmission Level Point
RF	Radio Frequency
rms	root-mean-square
SINAD	Signal-Plus-Noise-Plus-Distortion to Noise-Plus-Distortion Ratio
STANAG	Standardization Agreement

APPENDIX A

ACRONYMS (continued)

TADIL	Tactical Digital Information Link
TDM	Time Division Multiplex
TIMS	Transmission Impairment Measurement Set
TLP	Transmission Level Point
UHF	Ultra High Frequency
UUT	Unit Under Test
V	volts
V_o	Voltage
VF	Voice Frequency

APPENDIX B-1

MIL-STD-188-212 REQUIREMENTS MATRIX

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Table B-1. MIL-STD-188-212 Requirements Matrix

Ref Number	MIL-STD Paragraph	Requirements	Subtest Number
	4.7	Clock, equipment, timing, control, and alarm. The electrical characteristics of clock, equipment, timing, control, and alarm circuits shall comply with the applicable requirements of the current edition of MIL-STD-188-114. Additionally, clock, equipment, control, and timing shall comply with the applicable requirements of subparagraph 5.3.6 of MIL-STD-188-200.	
	5.1	General. The TADIL B system normally interconnects tactical air defense and aircraft control units of the implementing military services. TADIL B employs a dedicated, point-to-point, full duplex digital data link utilizing serial transmission frame characteristics and standard message formats transmitted by individual signal elements or binary digits (bits) on a time sequential basis. Signals may be transmitted in direct current (DC) digital form or the signals may be converted to quasi-analog form depending on the type of transmission subsystem employed. Typical system configurations for TADIL B systems using voice frequency (VF) channels or digital channels are shown in figure 1. The TADIL B system consists of two terminal subsystems and the transmission subsystem. The terminal subsystem may consist of user interface devices and a computer which converts data to a usable format, a buffer to compensate for any difference in the data signaling rate between the computer and transmission subsystem, and a signal converter such as a modulator/demodulator (modem) which converts the digital signals into quasi-analog signals for transmission over VF channels and reconverts incoming quasi-analog signals into digital signals. The arrangement of components may be modified by combining the buffer and modem in one unit or the buffer can be combined with the computer. It is not the intent of this standard to stipulate the format of the data transfer within composite components; however, the data transferred to the transmission subsystem will be in serial form and in the standard TADIL B transmission frame format. The transmission subsystem is composed of the transmission lines or interconnecting cables and a full duplex channel employing radio links, satellite links, or cable links. Also included in the transmission subsystem is the multiplex equipment (frequency division multiplex (FDM) or time division multiplex (TDM)) normally associated with multichannel radio subsystems.	

Table B-1. MIL-STD-188-212 Requirements Matrix (continued)

Ref Number	MIL-STD Paragraph	Requirements	Subtest Number
	5.2	Terminal subsystem characteristics. The terminal subsystem provides the capability to superimpose the TADIL B message formats onto the TADIL B transmission frame and buffer the messages to accommodate differences between the processing rate of the system and the data signaling rate. The terminal subsystem will also provide, when needed, signal conversion capabilities, such as modulation/demodulation, for interfacing with the transmission subsystem. The terminal subsystem also provides the interface with the user devices, such as keyboards and display devices. The requirements of 5.2.3 through 5.2.8.3.2 apply to all TADIL B terminal subsystems, regardless of the specific arrangements of equipment within the terminal subsystem and modulation of data signaling rates employed, except where stated otherwise in the applicable subparagraph.	
1	5.2.3	Data signaling rates. All TADIL B systems shall be capable of operating at a basic data signaling rate of 1200 bits per second (bps). As a DO, TADIL B systems should be capable of operating at a data signaling rate of 2400 bps or at higher standard data signaling rates specified in subparagraph 5.3.5.1 of MIL-STD-188-200.	1
2	5.2.5	Modem characteristics. All TADIL B modems shall comply with the applicable requirements of the current edition of MIL-STD-188-110.	1
3	5.2.5.1	Basic characteristics for 1200 bps. For the data signaling rate of 1200 bps, phase continuous frequency shift keying (FSK) shall be used with a center frequency of 1700 hertz (Hz), a Mark (1) frequency of 1300 Hz and a Space (0) frequency of 2100 Hz in accordance with MIL-STD-188-110.	1
4	5.2.7	Terminal subsystem BER. The BER attributable directly to the terminal subsystem shall not exceed 1 erroneous bit in 10,000,000 bits transmitted at the applicable modulation rate or data signaling rate, when the output of the transmitting terminal subsystem is connected directly to the input of the receiving terminal subsystem. This requirement shall be achieved while employing a test pattern over any continuous 5-hour period. The test pattern for measuring the BER shall be inserted at that point in the transmitting terminal subsystem which superimposes the TADIL B massage onto the TADIL B transmission frame format. The test pattern shall be measured at that point in the receiving terminal subsystem which samples the TADIL B transmission frame format. Note: The test pattern for measuring the BER is not standardized and will be defined in applicable equipment or subsystem specifications.	2
	5.2.8.1	Digital equipment interface characteristics.	

Table B-1. MIL-STD-188-212 Requirements Matrix (continued)

Ref Number	MIL-STD Paragraph	Requirements	Subtest Number
5	5.2.8.1.1	Electrical characteristics. The electrical characteristics of the interfaces between the equipment of the terminal subsystem shown in figure 1 shall comply with the applicable requirements of the current edition of MIL-STD-188-114. Note: Any or all of the equipment of the terminal subsystem may be integrated and combined into a single piece of equipment. When combined into a single piece of equipment, MIL-STD-188-114 does not apply to internal equipment connections.	3
6	5.2.8.2.1	Impedance. The impedance at the modulator output and the demodulator input shall each be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3400 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).	4
7	5.2.8.2.2	Quasi-analog signal levels. The transmitted quasi-analog signal level at the modulator output shall be adjusted such that the signal level stated in 5.3.2.1.5 is obtained at the input of the VF channel of the transmission subsystem. Note: The received quasi-analog signal level at the demodulator input is not standardized. This level depends on the quasi-analog signal level at the VF channel output, stated in 5.3.2.1.5, and the attenuator of the wire or cable connection between the output of the VF channel and the input of the terminal subsystem. (See figure 1.)	5
	5.2.8.2.3	Data signal connection. The exchange of quasi-analog data signals between the terminal subsystem and the transmission subsystem shall be by serial transfer of data bits over a single full duplex VF channel of the transmission subsystem. Note: Timing, control, and alarm functions may require additional connections between equipment located in the terminal subsystem and the transmission subsystem. (See paragraph 4.7)	
	5.2.8.3	Digital channel interface characteristic.	
8	5.2.8.3.1	Electrical characteristics. The electrical characteristics of the digital channel interface between the terminal subsystem and the transmission subsystem shall comply with the applicable requirements of the current edition of MIL-STD-I88-114.	3
	5.2.8.3.2	Data signal connection. The exchange of digital data signals between the terminal subsystems and the transmission subsystem shall be by serial transfer of data bits over a single full duplex digital channel of the transmission subsystem. (See Note of 5.2.8.2.3.)	

Table B-1. MIL-STD-188-212 Requirements Matrix (continued)

Ref Number	MIL-STD Paragraph	Requirements	Subtest Number
	5.3	Transmission subsystem characteristics. TADIL B terminal subsystems are interconnected with transmission subsystems (See figure 1) that provide a nominal 5-kHz full duplex VF channel or a full duplex digital channel. The channels are dedicated (non-switched) connections on a point-to-point basis and have transmission characteristics in accordance with the applicable requirements of MIL-STD-188-200. The transmission subsystem normally employs FDM or time division multiplex/pulse code modulation (TDM/PCM) wideband transmission facilities using line of sight (LOS) or tropospheric scatter radio links, or radio relay links. Cable links with and without repeaters, or satellite links may also be used, provided the channel derived by these links meets the applicable requirements of 5.3.2.1.1 through 5.3.3.4. The transmission subsystem will include the wire or cable connection from/to the terminal subsystem to/from the channel transmission equipment, such as multiplexer/demultiplexer equipment or cable interface converter equipment.	
	5.3.1	Types of tactical subsystems. Based on various requirements for multichannel trunking networks, different tactical multichannel subsystems and wideband radio transmission equipment have been designed. Multichannel subsystems are classified as tactical subsystems type I, II, III and IV. Table III summarizes the basic characteristics, and 5.3.1.1 through 5.3.1.4 briefly describe these different types of subsystems.	
	5.3.1.1	Tactical subsystem type I. This type is a multichannel transmission subsystem using FDM equipment and frequency modulation (FM) wideband LOS or tropospheric scatter radio links or radio relay links to cover distances up to several hundred kilometers (km). The FDM equipment provides nominal 5-kHz VF channels (See figure 3) and has been designed to operate with a quasi-analog signal level of -13 dBm0 and a test tone level of -10 dBm0 at the 4-wire input and output terminals of each VF channel and with a Zero Transmission Level Point (0TLP) at these terminals.	
	5.3.1.2	Tactical subsystem type II. This type is a multichannel transmission subsystem using TDM/PCM equipment and wideband LOS, tropospheric scatter or satellite radio links or radio relay links, or cable links with repeaters transmitting digital signals over distances of up to several hundred km. The TDM/PCM equipment provides nominal 4 kHz VF channels (See figure 3) and has been designed to operate with a quasi-analog signal level of -6 dBm0 and a test tone level of -3 dBm0 at the 4-wire input and output terminals of each VF channel and with a -4TLP at these terminals. For transmitting data in digital form over the tactical subsystem type II.	

Table B-1. MIL-STD-188-212 Requirements Matrix (continued)

Ref Number	MIL-STD Paragraph	Requirements	Subtest Number
	5.3.1.3	Tactical subsystem type III. This type is a multichannel transmission subsystem using FDM equipment and FM wideband LOS or tropospheric scatter radio links or radio relay links. The subsystem has been designed for much longer distances (up to 1800 km) than the tactical subsystems type I and type II. The FDM equipment provides nominal 4-kHz VF channels (See figure 3) and has been designed to operate with a quasi-analog signal level of -13 dBm0 at the 4-wire input and output terminals of each VF channel and with a 0TLP at these terminals.	
	5.3.1.4	Tactical subsystem type IV. This type is a multichannel TDM transmission subsystem under development that will employ continuously variable slope delta (CVSD) modulation as the analog-to-digital conversion method and digital wideband LOS, tropospheric scatter and satellite radio links. The subsystem will have the capability to interface with existing nominal 4-kHz VF channels (See figure 3) and will also have the capability to interconnect TADIL B terminal subsystems operating with digital signals at 1200 bps and higher standard data signaling rates, over a digital channel. Access over a digital channel will be the primary and preferred method of transmission in lieu of converting digital signals into quasi-analog signals for transmission over analog channels.	
	5.3.2.1	Input/output characteristics.	
	5.3.2.1.1	Standard test signal. The level of the standard test signal shall be 0 dBm at a 0TLP, or 0 dBm0, with a frequency of 1000 Hz, $\pm$25 Hz. A test signal frequency of 1004 Hz is preferred for PCM transmission. NOTE 1: The standard test signal is generally used for testing the peak power transmission capability and for measuring the harmonic distortion of a VF channel. In the tactical subsystem type II (See table III), the standard test signal is also used for level alignment of links in tandem, providing that the circuit to be aligned does not include links of the tactical subsystems type I or type III or a long haul system. The standard test signal should not be used in the tactical subsystem type I and type III for level alignment of links in tandem since the test signal may overload FDM channels. NOTE 2: The standard test signal (with a level of 0 dBm0) must not be transmitted across a VF channel interface between the tactical subsystem type II and the tactical subsystems type I or III in either direction. Any TLP of the tactical subsystem type II has to be considered internal to this subsystem and must not be related to a TLP of the tactical subsystems type I and type III in terms of signal levels. For interfacing VF channels of the tactical subsystem type II with VF channels of the tactical subsystem type I or type III, See 5.3.2.5.	

Table B-1. MIL-STD-188-212 Requirements Matrix (continued)

Ref Number	MIL-STD Paragraph	Requirements	Subtest Number
	5.3.2.1.2	Standard test tone. In the tactical subsystem type I and type III (See table III), the level of the standard test tone shall be -10 dBm0, that is -10 dBm at a 0TLP of these subsystems, with a frequency of 1000 Hz, ±25 Hz. In the tactical subsystem type II, the level of the standard test tone shall be -3 dBm0, that is -7 dBm at a -4TLP of that subsystem or -3 dBm at a 0TLP of that subsystem, with a frequency of 1000 Hz, ±25 Hz. (See note 3) A test tone frequency of 1004 Hz is preferred for PCM transmission. NOTE 1: The difference in test tone levels between the tactical subsystem type II and the tactical subsystems type I and type III, is caused by different traffic signal levels (voice and quasi-analog signals) at the respective 0TLP of the subsystem under consideration. The different traffic signal levels are based on different overload characteristics of the communications equipment employed in these subsystems. Therefore, any TLP of the tactical subsystem type II has to be considered internal to this subsystem and must not be related to a TLP of the tactical subsystem type I and type III in terms of signal levels. For interfacing VF channels of the tactical subsystem type I or type III, (See 5.3.2.5). NOTE 2: The standard test tone Is generally used for level alignment of VF channels of single links and of links in tandem in the tactical subsystem type I and type III. It has been found necessary to use, for link alignments, the much lower level of the standard test tone (as compared to the standard test signal) in order to prevent overloading of those multichannel wideband transmission subsystems that use FDM or radio equipment, or both, designed for voice service with an activity factor as low as 25 percent. This type of equipment is normally employed in tactical subsystem type I and III and in long haul systems. NOTE 3: In the tactical subsystem type II, the standard test tone should be used only for level alignment of VF channels of those links that interconnect, and form part of a circuit, with the tactical subsystem type I or III or a long haul system, details of this level alignment across a VF channel interface between the tactical subsystem type I or III and the tactical subsystem type II are stated in 5.3.2.5.	
9	5.3.2.1.4	Impedance. The impedance of the transmitting and receiving terminals of a nominal 4-kHz VF channel interface for quasi-analog signals shall each be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3400 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).	4

Table B-1. MIL-STD-188-212 Requirements Matrix (continued)

Ref Number	MIL-STD Paragraph	Requirements	Subtest Number
10	5.3.2.1.5	Quasi-analog signal levels. For the tactical subsystems type I and type III (See table III), the quasi-analog signal level shall be -13 dBm0 (i.e., -13 dBm at a 0TLP) at the input terminals, and shall be -13 dBm0, ±0.5 dB, at the output terminals of the FDM equipment of the transmission subsystem. For the tactical subsystem type II, the quasi-analog signal level shall be -6 dBm0 (i.e., -10 dBm at a -4TLP) at the input terminals and shall be -6 dBm0, ±0.5 dB, at the output terminals of the TDM/PCM equipment of the transmission subsystem. The interconnection between VF channels of the tactical subsystems type I or type III and VF channels of the tactical subsystem type II shall be in accordance with 5.3.2.5.	5
11	5.3.2.1.6	Channel noise power. For the tactical subsystem type I and type III (See table III), the non-impulse type of the total channel noise power (consisting of multiplex idle channel noise, multiplex loaded channel noise, and transmission media noise) shall not exceed 50,000 pW0 (47.0 dBrn0), when measured at or referenced to a 0TLP of the VF channel under consideration. For the tactical subsystem type II, the non-impulse type of the idle channel noise power shall not exceed 40,000 pW0 (46.0 dBrn0), when measured at or referenced to a 0TLP of the VF channel under consideration. The channel noise power shall be measured with flat weighting over the frequency band from 300 Hz to 3400 Hz.	6
12	5.3.2.1.7	Signal-to-noise ratio (SNR). The rms-signal-to-rms-noise ratio shall be at least 26 dB for data transmission with modulation rate of 2400 Bd or less over VF channels. The parameter shall be measured at the quasi-analog output terminals of the transmission subsystem with flat weighting over the frequency band occupied by the quasi-analog signals. Note: The SNR rated in 5.3.2.1.7 is a necessary but not sufficient requirement for acceptable data transmission since signal discontinuities (See 5.3.2.3) may increase the BER for certain unpredictable periods of time.	7
13	5.3.2.1.8	Single tone interference. No interfering single-frequency tone shall exceed 30 dBrn (DO: 24 dBrn), measured at the quasi-analog input terminals of the demodulator in the terminal subsystem with flat weighting over the frequency band from 300 Hz to 3400 Hz.	8
14	5.3.2.1.9	Frequency displacement. Any single-frequency signal transmitted over a VF channel shall be reproduced at the output terminals of this channel with a frequency error of not more than ±1 Hz for single links and not more than ±4 Hz for multiple links in tandem.	9
	5.3.2.2	Transfer function characteristics.	

Table B-1. MIL-STD-188-212 Requirements Matrix (continued)

Ref Number	MIL-STD Paragraph	Requirements	Subtest Number
15	5.3.2.2.2	Character-count and bit-count integrity. No extraneous characters of bits (See Note) shall be inserted or deleted in message texts. This requirement shall apply to all modulation and data signaling rates. The mean-time-between-losses of character-count and bit-count integrity shall be not less than 24 hours, measured from the data source of the transmitting terminal subsystem to the data sink of the receiving terminal subsystem. Note: Extraneous characters or bits include time differential blanks associated with asynchronous/synchronous transmission equipment. These characters or bits are permissible in the transmission subsystem if they can be recovered prior to forwarding the signal to the user interface device.	10
16	5.3.2.2.3	Insertion loss. The insertion loss of a VF channel shall be 0 dB, ±0.5 dB, measured at 1000 Hz, ±25 Hz.	5
17	5.3.2.2.4	Net loss variation. The net loss variation of a VF channel shall not exceed ±1 dB over any 15 consecutive minutes, and ±5 dB over any 30 consecutive days. Note: The above values do not account for net loss variations of unprotected field wire. Net losses of unprotected field wire may vary up to 0.7 dB/km between wet and dry weather conditions.	11
18	5.3.2.2.5	Insertion loss versus frequency characteristic. For data transmission with modulation rates of 1200 Bd or less over VF channels, the insertion loss versus frequency characteristic, referenced to 1000 Hz, shall not exceed the values given in table IV over the frequency bands stated. Loss is indicated by a (+) and gain by a (-) sign. (See figure 3A). Note: The parameter values listed in tables IV and are identical to the values for the D2 circuit parameters which are part of the DCS technical schedule published in DCAC 300-175-9. The DCS technical schedule is based on corresponding parameter values used by commercial carriers. The parameter values of the DCS technical schedule are considered to be the best information available to specify VF channel characteristics necessary for acceptable data transmission. However, experience has shown that VF channels may provide acceptable data service when the measured parameters are close to, but not exactly within the limits of the values listed in tables IV and V. Therefore, the parameter values listed in these tables should not be used exclusively to determine the need for regenerating data signals and conditioning data channels.	5
19	5.3.2.2.6	Envelope delay distortion. For data transmission with modulation rates of 1200 Bd or less over VF channels, the envelope delay distortion, measured between 800 Hz and 2600 Hz, shall not exceed the values given in table V over the frequency bands stated. (See figure 3B and note of 5.3.2.2.5.)	12

Table B-1. MIL-STD-188-212 Requirements Matrix (continued)

Ref Number	MIL-STD Paragraph	Requirements	Subtest Number
20	5.3.2.2.7	Total harmonic distortion. For data transmission with modulation rates of 2400 Bd or less over VF channels, the total harmonic distortion produced by any single-frequency test signal within the frequency band between 300 Hz and 3000 Hz shall be at a level which is at least 30 dB below reference level (-30 dBm0) with a DO of -40 dBm0. The total harmonic distortion shall be measured with a standard test signal in accordance with 5.3.2.1.1.	13
	5.3.2.3	Signal discontinuities.	
21	5.3.2.3.1	Impulse noise. For data transmission over VF channels, the impulse noise shall not exceed 15 counts above a level of 71 dBrn0 over any continuous 15-minute period. The impulse noise shall be measured at the quasi-analog input terminals of the demodulator of the receiving terminal subsystem with flat weighting over the frequency bandwidth occupied by the quasi-analog signals. The test instrument shall be capable of counting rates of up to 7.5 counts per second.	15
22	5.3.2.3.4	Phase jitter. The total peak-to-peak phase jitter, imparted to a test tone traversing a VF channel at any frequency between 300 Hz and 3000 Hz, shall not exceed 15 degrees (DO: 10 degrees).	16
23	5.3.2.3.5	Phase hits. For data transmission over VF channels, the number of phase hits of greater than $\pm$20 degrees shall not exceed 15 hits over any continuous 15-minute period.	16

Table B-1. MIL-STD-188-212 Requirements Matrix (continued)

Ref Number	MIL-STD Paragraph	Requirements	Subtest Number
	5.3.2.5	Special method for interconnecting VF channels of the tactical Subsystems type I or III with type II. VF channels of the tactical subsystems type I or type III (See table III) shall be interconnected with VF channels of the tactical subsystem type II on the basis of the standard test tone levels in accordance with 5.3.2.1.2, and not on the basis of the TLP of these subsystems. (See figure 4). Note: The special method for interconnecting VF channels in accordance with the requirement of 5.3.2.5 results in a gain of 3 dB at the interface point for quasi-analog signals traversing from the tactical subsystems type I or type III to the tactical subsystem type II, and in an Attenuator of 3 dB at the interface point for signals traversing in the opposite direction, as shown in figure 4.	

Note: Sections that are informational in nature are shaded.
Legend:

± - plus or minus	dc - direct current	MHz - megahertz
µV - microvolts	DCS -Dual Channel Switch	MIL-HDBK - Military Handbook
- - minus	DO - Design Objective	MIL-STD - Military Standard
+ - plus	f - frequency	modem - modulator/demodulator
0TLP - Zero Transmission Level Point	FDM - Frequency Division Multiplex	PCM - Pulse Code Modulation
Bd - baud	FSK - Frequency Shift Keying	pW0 - picowatt, referenced to Zero Transmission Level Points
BER - Bit Error Ratio	FM - Frequency Modulation	RF - Radio Frequency
bps - bits per second	Hz - hertz	rms - root-mean-square
CVSD - Continuously Variable Slope Delta	kHz - kilohertz	SNR - Signal-to-Noise Ratio
dB - decibels	km - kilometers	TADIL - Tactical Digital Information Link
dBm - dB referred to one milliwatt	LOS - Line of Sight	TEMPEST - (See FED-STD-1037)
dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point		TDM - Time Division Multiplex
dBrn - decibels above reference noise	MHz - megahertz	TLP - Transmission Level Point
dBrn0 - decibels above reference noise, referenced to Zero Transmission Level Point		UHF - Ultra High Frequency
DCAC - Defense Communications Agency Circular		VF - Voice Frequency

APPENDIX B-2

STANAG 5511, ANNEX B REQUIREMENTS MATRIX

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Table B-2. STANAG 5511, Annex B Requirements Matrix

Ref Number	STANAG Paragraph	Requirements	Subtest Number
	2.2.1	Original Standard	
24	2.2.1.a	The Modulation shall be phase continuous frequency-shift modulation used with the following characteristics: Basic Speed — 1200 bits per second Center Frequency — 1700 ± 5 Hz Space Frequency (0) — 2100 ± 5 Hz Mark Frequency (1) — 1300 ± 5 Hz Alternate Speed — 600 bits per second Center Frequency — 1500 ± 5 Hz Space Frequency (0) — 1700 ± 5 Hz Mark Frequency (1) — 1300 ± 5 Hz	1
25	2.2.1.b	The nominal bandwidth at 1200 bits per second shall be 4 kHz.	17
26	2.2.1.c	The nominal 3 dB points for the bandpass shall be within ± 2 dB for all frequencies between 1000 and 2400 Hz with respect to the attenuator of a 1000-Hz signal.	17
26	2.2.1.d	The delay distortion in the frequency band between 600 and 2700 Hz shall not exceed 300 microseconds and in the frequency band between 1000 and 2500 Hz shall not exceed 200 microseconds.	12
27	2.2.1.e	The total harmonic distortion within the band between 600 and 2700 Hz produced by any single frequency test signal shall be at least 30 dB below reference (-30 dBm0).	13
28	2.2.1.f	The individual intermodulation distortion products within the band between 600 Hz and 2700 Hz produced by any two equal level tones introduced at -3 dBm0 in that band shall be no greater than -38 dBm0.	14
29	2.2.1.g	The frequency translation introduced by any single link due to the difference in carrier frequencies at each end of the link shall not exceed 1.0 Hz.	9
	7.3	UHF Transmitters	
	7.3.a	Audio input. The audio input shall be balanced and ungrounded with 600-ohms terminations. The rms levels at the input shall be 0 dBm, with a peak rms voltage level of 10.3 dB	
30	7.3.b	Audio bandwidth. The audio frequency response between ± 1.5-dB limits shall be 300 Hz and 3500 Hz.	17
31	7.3.c	Deviation. A signal of + 10 dBm at the audio output shall produce up to ± 20-kHz deviation of the output frequency.	18
32	7.3.d	Frequency stability. After an initial warm-up period not exceeding 5 minutes, the deviation from the selected carrier frequency in the absence of modulation shall not exceed ± 2.5 kHz.	9
33	7.3.e	Radiated output levels. The transmitted output level shall be within 1 dB of its steady-state output within 7 ms of the receipt of a keying signal.	19
34	7.3.f	Linearity. Intermodulation distortion shall be 30 dB below a two-tone test (935 and 1045 Hz) for a frequency deviation of ± 20 kHz.	14
	7.4	UHF Receiver	

Table B-2. STANAG 5511, ANNEX B Requirements Matrix (continued)

Ref Number	STANAG Paragraph	Requirements	Subtest Number
35	7.4.a	Output levels. The receiver output shall be within 1 dB of its steady-state value within 12 ms after application of the RF signal. The output level shall be constant, within ± 3 dB for inputs from 5 microvolts to 50 millivolts (hard).	19
36	7.4.b	Audio bandwidth. The audio frequency response between ± 1.5-dB limits shall be 300 Hz to 3500 Hz.	17
37	7.4.c	Deviation. An input of ± 20-kHz deviation and 100 microvolts (hard) to the receiver shall produce a signal output of +10 dBm.	18
38	7.4.d	Linearity. Intermodulation distortion shall be 30 dB below a two-tone test (935 and 1045 Hz) for a frequency deviation of ± 20 kHz.	14
39	7.4.e	Protection. The receiver shall be protected when the transmitter is a full power and the electrical isolation between the transmitter and receiver antenna terminals is as low as 26 dB. The protection circuit shall activate within 150 ms time interval used by the transmitter to go from the carrier "on" to the carrier "off" condition. Provisions shall be made to override the protection circuitry to the extent required to monitor the transmitter at full power. The override feature shall provide the required receiver output when the electrical isolation between the transmitter antenna terminal and receiver antenna terminals is in the range 26 dB to 36 dB.	20
40	7.5	UHF accuracy and stability. The accuracy of any selected carrier frequency shall not vary more than ± 5 parts in 1,000,000 for a period of 6 months after a warm period of 30 minutes under any combination of specified service condition. An adjustment control shall be provided to permit the equipment to be periodically calibrated or aligned to within one part in 10,000,000 of the designated frequency.	9

Legend:
± - plus or minus
dB - decibels
dBm - dB referred to one milliwatt
dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point
Hz - hertz
kHz - kilohertz
ms - milliseconds
RF - Radio Frequency
rms - root-mean-square
rms - root-mean-square
STANAG - Standardization Agreement
UHF - Ultra High Frequency

APPENDIX C

DATA COLLECTION FORMS

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MIL-STD-188-212/STANAG 5511, ANNEX B CONFORMANCE TEST PROCEDURES Forms Control	CONTROL NUMBER:
	DATE: (DD/MM/YY)

Form Number	Serial Number	Equipment Nomenclature	Call Sign	Remarks

DATA ENTRY TECHNICIAN:	TEST DIRECTOR:
SIGNATURE:	SIGNATURE:

RADIO FREQUENCY TEST FACILITY

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MIL-STD-188-212/STANAG 5511, ANNEX B CONFORMANCE TEST PROCEDURES Additional Remarks Form	CONTROL NUMBER:
	DATE: (DD/MM/YY)
Remarks	
TEST TECHNICIAN:	
DATA ENTRY TECHNICIAN:	TEST DIRECTOR:

RADIO FREQUENCY TEST FACILITY

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MIL-STD-188-212/STANAG 5511, ANNEX B CONFORMANCE TEST PROCEDURES Event Log Form	CONTROL NUMBER:
	DATE: (DD/MM/YY)

Time (Z)	Initials	Event

TEST TECHNICIAN:	
DATA ENTRY TECHNICIAN:	TEST DIRECTOR:

RADIO FREQUENCY TEST FACILITY

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MIL-STD-188-212/STANAG 5511, ANNEX B CONFORMANCE TEST PROCEDURES Equipment Configuration Diagram Form	CONTROL NUMBER:
	DATE: (DD/MM/YY)

TEST TECHNICIAN:	
DATA ENTRY TECHNICIAN:	TEST DIRECTOR:

RADIO FREQUENCY TEST FACILITY

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MIL-STD-188-212 CONFORMANCE TEST Subtest 3, Criterion C Electrical Characteristics of Digital Interfaces	CONTROL NUMBER: DATE: (DD/MM/YY)

Criterion C	Unbalanced values of figure 3-1	Measured Value	Met	Not Met
Open Circuit Measurement	$4\text{ V} \le \lvert V_o \rvert \le 6\text{ V}$			
Test Termination measurement	$\lvert Vt \rvert \ge 0.9 \lvert V_o \rvert$, when Rt = 450 ohm, ± 1 percent			
Short Circuit Measurement	$\lvert Is \rvert \le 150\text{ mA}$			
Power off Measurement	$\lvert Ix \rvert \le 100\ \mu\text{A}$, when $-6\text{ V} \le Vx \le +6\text{ V}$			

NOTE: Actual requirements can be located on page 13 of test procedures. Values reflect figure 3-1.

EQUIPMENT TESTED:

RADIO TYPE: ________________ SERIAL Number: _______________

RADIO TYPE: ________________ SERIAL Number: _______________

DTD TYPE: __________________ SERIAL Number: _______________

DATA TERMINAL: ____

REMARKS:
____

TEST TECHNICIAN:	
DATA ENTRY TECHNICIAN:	TEST DIRECTOR:

Page 1 of 2

MIL-STD-188-212 CONFORMANCE TEST Subtest 3, Criterion D Electrical Characteristics of Digital Interfaces	CONTROL NUMBER:
	DATE: (DD/MM/YY)

Criterion D	Balanced Values of figure 3-2	Measured Value	Met	Not Met
Open Circuit Measurement	4 V ≤ $\lvert V_o \rvert$ ≤ 6 V			
	2 V ≤ $\lvert Voa \rvert$ ≤ 3 V and 2 V ≤ $\lvert Vob \rvert$ ≤ 3 V			
Test Termination measurement	$\lvert Vt \rvert \geq 0.5 \lvert V_o \rvert$			
	$\lvert Vt \rvert - \lvert Vt \rvert \leq 0.4$ V			
	$\lvert Vos - Vos \rvert \leq 0.4$ V			
	$\lvert Vos \rvert \leq 0.4$ V.			
Short Circuit Measurement	$\lvert Isa \rvert \leq 150$ mA and $\lvert Isb \rvert \leq 150$ mA			
Power off Measurement	$\lvert Ixa \rvert \leq 100$ μA and $\lvert Ixb \rvert \leq 100$ μA, when -6 V ≤ Vx ≤ +6 V			

NOTE: Actual requirements can be located on page 14 of test procedures. Values reflect figure 3-2.

EQUIPMENT TESTED:

RADIO TYPE: ________________ SERIAL Number: ________________

RADIO TYPE: ________________ SERIAL Number: ________________

DTD TYPE: ________________ SERIAL Number: ________________

DATA TERMINAL: ____

REMARKS:

____

TEST TECHNICIAN:	
DATA ENTRY TECHNICIAN:	TEST DIRECTOR:

APPENDIX D-1

MIL-STD-188-212 TEST RESULTS MATRIX

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Table D-1. MIL-STD-188-212 Test Results Matrix

MIL-STD 188-212 Paragraph	Requirement	Subtest	Findings	
			Met	Not Met
5.2.3	Data signaling rates. All TADIL B systems shall be capable of operating at a basic data signaling rate of 1200 bits per second (bps). As a DO, TADIL B systems should be capable of operating at a data signaling rate of 2400 bps or at higher standard data signaling rates specified in subparagraph 5.3.5.1 of MIL-STD-188-200.	1		
5.2.5	Modem characteristics. All TADIL B modems shall comply with the applicable requirements of the current edition of MIL-STD-188-110.	1		
5.2.5.1	Basic characteristics for 1200 bps. For the data signaling rate of 1200 bps, phase continuous frequency shift keying (FSK) shall be used with a center frequency of 1700 hertz (Hz), a Mark (1) frequency of 1300 Hz and a Space (0) frequency of 2100 Hz in accordance with MIL-STD-188-110.	1		
5.2.7	Terminal subsystem BER. The BER attributable directly to the terminal subsystem shall not exceed 1 erroneous bit in 10,000,000 bits transmitted at the applicable modulation rate or data signaling rate, when the output of the transmitting terminal subsystem is connected directly to the input of the receiving terminal subsystem. This requirement shall be achieved while employing a test pattern over any continuous 5-hour period. The test pattern for measuring the BER shall be inserted at that point in the transmitting terminal subsystem which superimposes the TADIL B massage onto the TADIL B transmission frame format (See 5.2.1). The test pattern shall be measured at that point in the receiving terminal subsystem which samples the TADIL B transmission frame format. Note: The test pattern for measuring the BER is not standardized and will be defined in applicable equipment or subsystem specifications.	2		

Table D-1. MIL-STD-188-212 Test Results Matrix (continued)

MIL-STD 188-212 Paragraph	Requirement	Subtest	Findings	
			Met	Not Met
5.2.8.1.1	Electrical characteristics. The electrical characteristics of the interfaces between the equipment of the terminal subsystem shown in figure 1 shall comply with the applicable requirements of the current edition of MIL-STD-188-114. Note: Any or all of the equipment of the terminal subsystem may be integrated and combined into a single piece of equipment. When combined into a single piece of equipment, MIL-STD-188-114 does not apply to internal equipment connections.	3		
5.2.8.2.1	Impedance. The impedance at the modulator output and the demodulator input shall each be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3400 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).	4		
5.2.8.2.2	Quasi-analog signal levels. The transmitted quasi-analog signal level at the modulator output shall be adjusted such that the signal level stated in 5.3.2.1.5 is obtained at the input of the VF channel of the transmission subsystem. Note: The received quasi-analog signal level at the demodulator input is not standardized. This level depends on the quasi-analog signal level at the VF channel output, stated in 5.3.2.1.5, and the Attenuator of the wire or cable connection between the output of the VF channel and the input of the terminal subsystem. (See figure 1.)	5		
5.2.8.3.1	Electrical characteristics. The electrical characteristics of the digital channel interface between the terminal subsystem and the transmission subsystem shall comply with the applicable requirements of the current edition of MIL-STD-I88-114.	3		
5.3.2.1.4	Impedance. The impedance of the transmitting and receiving terminals of a nominal 4-kHz VF channel interface for quasi-analog signals shall each be 600 ohms, balanced to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency band from 300 Hz to 3400 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents to a level which is at least 40 dB below reference level (-40 dBm0).	4		

Table D-1. MIL-STD-188-212 Test Results Matrix (continued)

MIL-STD 188-212 Paragraph	Requirement	Subtest	Findings	
			Met	Not Met
5.3.2.1.5	Quasi-analog signal levels. For the tactical subsystems type I and type III (See table III), the quasi-analog signal level shall be -13 dBm0 (i.e., -13 dBm at a 0TLP) at the input terminals, and shall be -13 dBm0, dB, at the output terminals of the FDM equipment of the transmission subsystem. For the tactical subsystem type II, the quasi-analog signal level shall be -6 dBm0 (i.e., -10 dBm at a -4TLP) at the input terminals and shall be -6 dBm0, $\pm$0.5 dB, at the output terminals of the TDM/PCM equipment of the transmission subsystem. The interconnection between VF channels of the tactical subsystems type I or type III and VF channels of the tactical subsystem type II shall be in accordance with 5.3.2.5.	5		
5.3.2.1.6	Channel noise power. For the tactical subsystem type I and type III (See table III), the non-impulse type of the total channel noise power (consisting of multiplex idle channel noise, multiplex loaded channel noise and transmission media noise) shall not exceed 50,000 pW0 (47.0 dBrn0), when measured at or referenced to a 0TLP of the VF channel under consideration. For the tactical subsystem type II, the non-impulse type of the idle channel noise power shall not exceed 40,000 pW0 (46.0 dBrn0), when measured at or referenced to a 0TLP of the VF channel under consideration. The channel noise power shall be measured with flat weighting over the frequency band from 300 Hz to 3400 Hz.	6		
5.3.2.1.7	Signal-to-noise ratio (SNR). The rms-signal-to-rms-noise ratio shall be at least 26 dB for data transmission with modulation rate of 2400 Bd or less over VF channels. The parameter shall be measured at the quasi-analog output terminals of the transmission subsystem with flat weighting over the frequency band occupied by the quasi-analog signals. Note: The SNR rated in 5.3.2.1.7 is a necessary but not sufficient requirement for acceptable data transmission since signal discontinuities (See 5.3.2.3) may increase the BER for certain unpredictable periods of time.	7		
5.3.2.1.8	Single tone interference. No interfering single-frequency tone shall exceed 30 dBrn (DO: 24 dBrn), measured at the quasi-analog input terminals of the demodulator in the terminal subsystem with flat weighting over the frequency band from 300 Hz to 3400 Hz.	8		

Table D-1. MIL-STD-188-212 Test Results Matrix (continued)

MIL-STD 188-212 Paragraph	Requirement	Subtest	Findings	
			Met	Not Met
5.3.2.1.9	Frequency displacement. Any single-frequency signal transmitted over a VF channel shall be reproduced at the output terminals of this channel with a frequency error of not more than ±1 Hz for single links and not more than ±4 Hz for multiple links in tandem.	9		
5.3.2.2.2	Character-count and bit-count integrity. No extraneous characters of bits (See Note) shall be inserted or deleted in message texts. This requirement shall apply to all modulation and data signaling rates. The mean-time-between-losses of character-count and bit-count integrity shall be not less than 24 hours, measured from the data source of the transmitting terminal subsystem to the data sink of the receiving terminal subsystem. Note: Extraneous characters or bits include time differential blanks associated with asynchronous/synchronous transmission equipment. These characters or bits are permissible in the transmission subsystem if they can be recovered prior to forwarding the signal to the user interface device.	10		
5.3.2.2.3	Insertion loss. The insertion loss of a VF channel shall be 0 dB, ±0.5 dB, measured at 1000 Hz, ±25 Hz.	5		
5.3.2.2.4	Net loss variation. The net loss variation of a VF channel shall not exceed ±1 dB over any 15 consecutive minutes, and ±5 dB over any 30 consecutive days. Note: The above values do not account for net loss variations of unprotected field wire. Net losses of unprotected field wire may vary up to 0.7 dB/km between wet and dry weather conditions.	11		

Table D-1. MIL-STD-188-212 Test Results Matrix (continued)

MIL-STD 188-212 Paragraph	Requirement	Subtest	Findings	
			Met	Not Met
5.3.2.2.5	Insertion loss versus frequency characteristic. For data transmission with modulation rates of 1200 Bd or less over VF channels, the insertion loss versus frequency characteristic, referenced to 1000 Hz, shall not exceed the values given in table IV over the frequency bands stated. Loss is indicated by a (+) and gain by a (-) sign. (See figure 3A.) Note: The parameter values listed in tables IV and are identical to the values for the D2 circuit parameters which are part of the DCS technical schedule published in DCAC 300-175-9. The DCS technical schedule is based on corresponding parameter values used by commercial carriers. The parameter values of the DCS technical schedule are considered to be the best information available to specify VF channel characteristics necessary for acceptable data transmission. However, experience has shown that VF channels may provide acceptable data service when the measured parameters are close to, but not exactly within the limits of the values listed in tables IV and V. Therefore, the parameter values listed in these tables should not be used exclusively to determine the need for regenerating data signals and conditioning data channels.	5		
5.3.2.2.6	Envelope delay distortion. For data transmission with modulation rates of 1200 Bd or less over VF channels, the envelope delay distortion, measured between 800 Hz and 2600 Hz, shall not exceed the values given in table V over the frequency bands stated. (See figure 3B and Note of 5.3.2.2.5.)	12		
5.3.2.2.7	Total harmonic distortion. For data transmission with modulation rates of 2400 Bd or less over VF channels, the total harmonic distortion produced by any single-frequency test signal within the frequency band between 300 Hz and 3000 Hz shall be at a level which is at least 30 dB below reference level (-30 dBm0) with a DO of -40 dBm0. The total harmonic distortion shall be measured with a standard test signal in accordance with 5.3.2.1.1.	13		
5.3.2.3.1	Impulse noise. For data transmission over VF channels, the impulse noise shall not exceed 15 counts above a level of 71 dBrn0 over any continuous one 5-minute period. The impulse noise shall be measured at the quasi-analog input terminals of the demodulator of the receiving terminal subsystem with flat weighting over the frequency bandwidth occupied by the quasi-analog signals. The test instrument shall be capable of counting rates of up to 7.5 counts per second.	15		

Table D-1. MIL-STD-188-212 Test Results Matrix (continued)

MIL-STD 188-212 Paragraph	Requirement	Subtest	Findings	
			Met	Not Met
5.3.2.3.4	Phase jitter. The total peak-to-peak phase jitter, imparted to a test tone traversing a VF channel at any frequency between 300 Hz and 3000 Hz, shall not exceed 15 degrees (DO: 10 degrees).	16		
5.3.2.3.5	Phase hits. For data transmission over VF channels, the number of phase hits of greater than ±20 degrees shall not exceed 15 hits over any continuous 15-minute period.	16		

Legend:

± - plus or minus
μV - microvolts
- - minus
+ - plus
Bd - baud
BER - Bit Error Rate
bits - individual single elements or binary digits
bps - bits per second
dB - decibels
dBm - dB referred to one milliwatt
dBm0 - noise power in dBm referred to or measured at Zero TLP
dBrn - decibels above reference noise
dBrn0 - decibels above reference noise, referenced to Zero TLP
DCS - Defense Communication System
DCAC - Defense Communication Agency Circular
DO - Design Objective
FDM - Frequency Division Multiplex
FSK - Frequency Shift Keying
FM - Frequency Modulation
Hz - hertz
kHz - kilohertz
km - kilometers
MIL-STD - Military Standard
ms - milliseconds
PCM - Pulse Code Modulation
pW0 - picowatt(s), referenced to Zero TLP
rms - root-mean-square
SNR - Signal-to-Noise Ratio
TADIL - Tactical Digital Information Link
TDM - Time Division Multiplex
TLP - Transmission Level Point
VF - Voice Frequency

APPENDIX D-2

STANAG 5511, ANNEX B
TEST RESULTS MATRIX

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Table D-2. STANAG 5511, Annex B Test Results Matrix

STANAG 5511 Annex B Paragraph	Requirement	Subtest	Findings	
			Met	Not Met
2.2.1.a	Alternate Speed 600 bits per second Center Frequency 1500 ± 5 Hz Space Frequency (0) 1700 ± 5 Hz Mark Frequency (1) 1300 ± 5 Hz	1		
2.2.1.b	The nominal bandwidth at 1200 bits per second shall be 4 kHz.	17		
2.2.1.c	The nominal 3-dB points for the bandpass shall be within ± 2 dB for all frequencies between 1000 and 2400 Hz with respect to the attenuator of a 1000-Hz signal.	17		
2.2.1.d	The delay distortion in the frequency band between 600 and 2700 Hz shall not exceed 300 microseconds and in the frequency band between 1000 and 2500 Hz shall not exceed 200 microseconds.	12		
2.2.1.e	The total harmonic distortion within the band between 600 and 2700 Hz produced by any single frequency test signal shall be at least 30 dB below reference (-30 dBm0).	13		
2.2.1.f	The individual intermodulation distortion products within the band between 600 Hz and 2700 Hz produced by any two equal level tones introduced at -3 dBm0 in that band shall be no greater than -38 dBm0.	14		
2.2.1.g	The frequency translation introduced by any single link due to the difference in carrier frequencies at each end of the link shall not exceed 1.0 Hz.	9		
7.3.b	Audio bandwidth. The audio frequency response between ± 1.5-dB limits shall be 300 Hz and 3500 Hz.	17		
7.3.c	Deviation. A signal of + 10 dBm at the audio output shall produce up to ± 20-kHz deviation of the output frequency.	18		
7.3.d	Frequency stability. After an initial warm-up period not exceeding 5 minutes, the deviation from the selected carrier frequency in the absence of modulation shall not exceed ± 2.5 kHz.	9		
7.3.e	Radiated output levels. The transmitted output level shall be within 1 dB of its steady-state output within 7 ms of the receipt of a keying signal.	34		
7.3.f	Linearity. Intermodulation distortion shall be 30 dB below a two-tone test (935 and 1045 Hz) for a frequency deviation of ± 20 kHz.	14		
7.4.a	Output levels. The receiver output shall be within 1 dB of its steady-state value within 12 ms after application of the RF signal. The output level shall be constant, within ± 3 dB for inputs from 5 microvolts to 50 millivolts (hard).	19		

Table D-2. STANAG 5511, Annex B Test Results Matrix (continued)

STANAG 5511 Annex B Paragraph	Requirement	Subtest	Findings	
			Met	Not Met
7.4.b	Audio bandwidth. The audio frequency response between ± 1.5 dB-limits shall be 300 Hz to 3500 Hz.	17		
7.4.c	Deviation. An input of ± 20-kHz deviation and 100 microvolts (hard) to the receiver shall produce a signal output of 10 dBm.	18		
7.4.d	Linearity. Intermodulation distortion shall be 30 dB below a two-tone test (935 and 1045 Hz) for a frequency deviation of ± 20 kHz.	14		
7.4.e	Protection. The receiver shall be protected when the transmitter is a full power and the electrical isolation between the transmitter and receiver antenna terminals is as low as 26 dB. The protection circuit shall activate within 150 ms time interval used by the transmitter to go from the carrier "ON" to the carrier "OFF" condition. Provisions shall be made to override the protection circuitry to the extent required to monitor the transmitter at full power. The override feature shall provide the required receiver output when the electrical isolation between the transmitter antenna terminal and receiver antenna terminals is in the range 26 dB to 36 dB.	20		
7.5	UHF accuracy and stability. The accuracy of any selected carrier frequency shall not vary more than ± 5 parts in 1,000,000 for a period of 6 months after a warm-up period of 30 minutes under any combination of specified service condition. An adjustment control shall be provided to permit the equipment to be periodically calibrated or aligned to within one part in 10,000,000 of the designated frequency.	9		

Legend:

± - plus or minus
+ - plus
dB - decibels
dBm - dB referred to one milliwatt
dBm0 - noise power in dBm referred to or measured at Zero Transmission Level Point
Hz - hertz
kHz - kilohertz
ms - millisecond
RF - Radio Frequency
STANAG - Standardization Agreement
UHF - Ultra High Frequency

APPENDIX E

REFERENCES

DEFENSE INFORMATION SYSTEMS AGENCY (DISA) CIRCULAR

E-1 DISA CIRCULAR 300-175-9, "Operating-Maintenance Electrical Performance Standards," 8 June 1998

MILITARY HANDBOOK (MIL-HDBK)

E-2 MIL-HDBK-232, "RED/BLACK Engineering-Installation Guidelines (U)," 25 July 1988

MILITARY STANDARDS (MIL-STD)

E-3 MIL-STD-188-110B, "Interoperability and Performance Standards for Data Modems," 27 April 2000

E-4 MIL-STD-188-114A, "Electrical Characteristics of Digital Interface Circuits," 13 December 1991

E-5 MIL-STD-188-200, "System Design and Engineering Standards for Tactical Communications," 28 June 1983

NATIONAL COMSEC INFORMATION MEMORANDUM (NACSIM)

E-6 NACSIM 5100, "Compromising Emanations Laboratory Test Requirements, Electromagnetic," No date

NATIONAL COMMUNICATIONS SECURITY/EMANATIONS MEMORANDUM (NACSEM)

E-7 NACSEM 5201, "Tempest Guidelines for Equipment /System Design (U)," September 1978